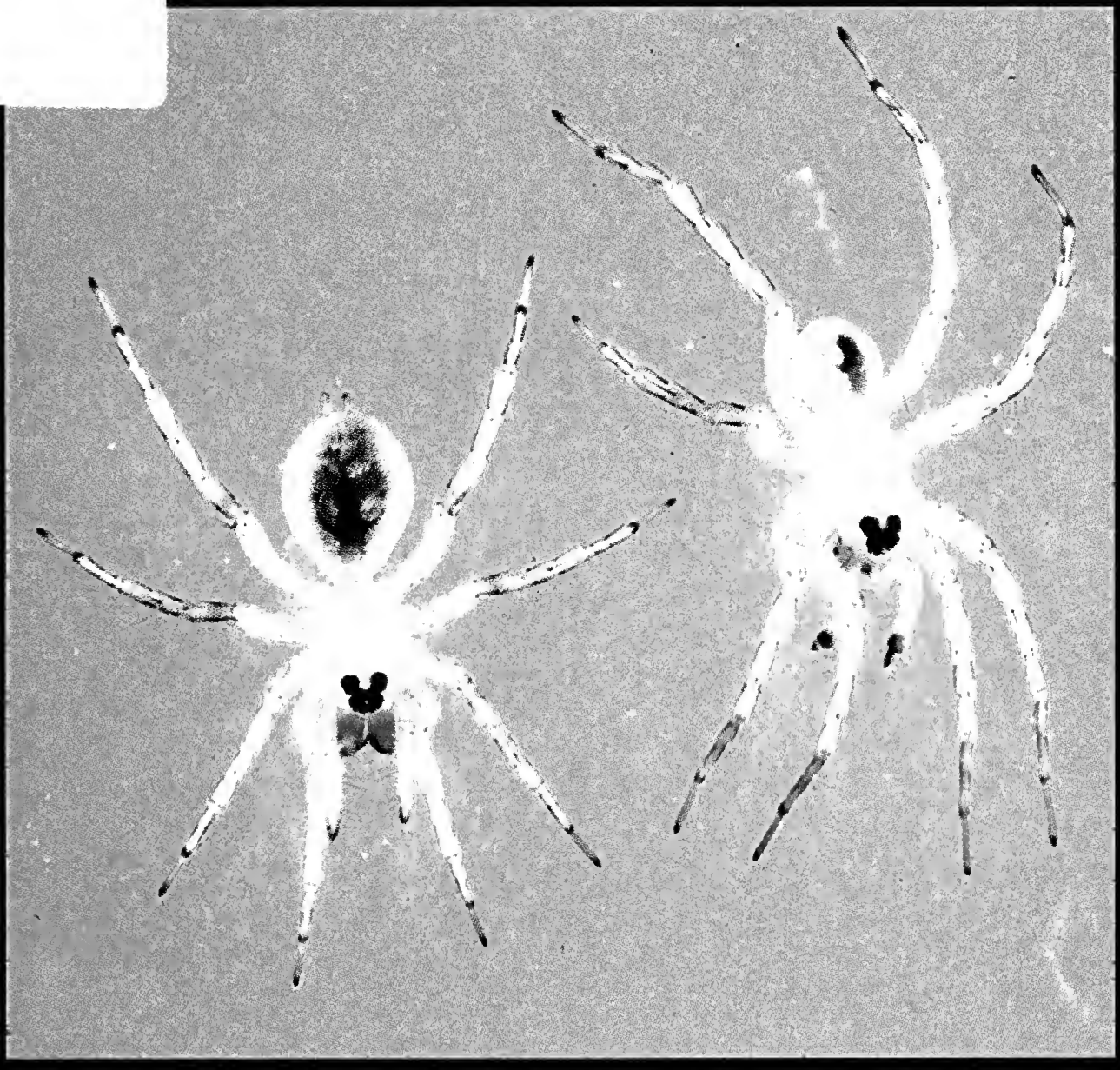
THE JOURNAL OF THE ALABAMA ACADEMY OF SCIENCE



VOLUME 71 OCTOBER 2000 NO. 4

Cover Photograph:

Male (left) and female (right) Wolf Spider, *Arctosa sanctaerosae*. In the male the ends of the palpi are enlarged for the transfer of sperm into the female. the female lacks palpal swellings and has an enlarged abdomen.

Photo Credit: R.L. Jenkins

THE JOURNAL
OF THE
ALABAMA ACADEMY
OF SCIENCE

AFFILIATED WITH THE
AMERICAN ASSOCIATION FOR THE
ADVANCEMENT OF SCIENCE

VOLUME 71 OCTOBER 2000 NO. 4

Publication and Subscription Policies

Submission of manuscripts: Submit all manuscripts and pertinent correspondence to the EDITOR. Each manuscript will receive two simultaneous reviews. For style details, follow instructions to Authors (see inside back cover).

Reprints. Requests for reprints must be addressed to Authors.

Subscriptions and Journal Exchanges: Address all Correspondence to the CHAIRMAN OF THE EDITORIAL BOARD

ISSN 002-4112

BENEFACTORS OF THE JOURNAL OF THE ALABAMA ACADEMY OF SCIENCE

The following have provided financial support
to partially defray publication costs of the Journal.

AUBURN UNIVERSITY
BIRMINGHAM-SOUTHERN COLLEGE
UNIVERSITY OF MONTEVALLO
AUBURN UNIVERSITY AT MONTGOMERY
UNIVERSITY OF SOUTH ALABAMA
TROY STATE UNIVERSITY
UNIVERSITY OF ALABAMA AT BIRMINGHAM
JACKSONVILLE STATE UNIVERSITY
SAMFORD UNIVERSITY
UNIVERSITY OF ALABAMA
TUSKEGEE UNIVERSITY
UNIVERSITY OF MOBILE
UNIVERSITY OF NORTH ALABAMA

Journal of the Alabama Academy of Science, Vol. 71, No. 4, October 2000.

CONTENTS

Articles

Journal of the Alabama Academy of Science, Vol. 71, No. 4, October 2000.

ECOLOGY OF THE WOLF SPIDER, *ARCTOSA SANCTAEROSAE* (ARANEAE, LYCOSIDAE), ON DAUPHIN ISLAND, ALABAMA

Heather McNatt
Department of Biology
University of Alabama at Birmingham
Birmingham, AL 35294

Ronald L. Jenkins and W. Mike Howell
Department of Biology
Samford University
Birmingham, AL 35229

ABSTRACT

Arctosa sanctaerosae (Gertsch and Wallace, 1935) is a North American wolf spider that inhabits sandy beaches of the northern Gulf of Mexico. In 1983, Dondale and Redner reported that its range extended from the panhandle of Florida west to Mississippi. Dauphin Island, a barrier island situated 8.9 km off the coast of Alabama, harbors an isolated population of these spiders. *Arctosa sanctaerosae* was surveyed at different beach locations on the island at various times throughout the year in a variety of climatic conditions in an effort to determine its ecology. This study concluded that *A. sanctaerosae* prefers beach areas with extensive dune systems and is most prevalent on the secondary dune of said systems. The stretch of beach on Dauphin Island that possesses dune areas with such a high degree of structure was situated on the gulf side between the Audubon Bird Sanctuary and the Dauphin Island Sea Lab.

INTRODUCTION

Arctosa sanctaerosae, family Lycosidae, is a wolf spider. Defining characteristics of this family include an anterior row of four small eyes, a recurved posterior row of four larger eyes, and the presence of three claws on the last segment of the leg (Kaston, 1978; Jackman, 1997). Wolf spiders are typically nocturnal hunters and rarely make webs. Females are well-known for their habit of transporting egg sacs on their spinnerets (Jackman, 1997). *A. sanctaerosae* can easily be distinguished from other members of its family. It is off-white to orange and possesses a bluish, gray, or tan anterodorsal abdominal mark commonly referred to as the cardiac mark (Cover photo). Diagnostic characters of the species include the presence of a single, dorsal macrosetae on tibia I and three teeth on the promargin of the cheliceral fang furrow (Dondale and Redner, 1983). The holotype, allotype and paratypes of this species were

all collected on Santa Rosa Island, Florida by H. K. Wallace in the spring of 1934 (Dondale and Redner, 1983). In 1935 Willis Gertsch and H. K. Wallace provided the original description for the spider.

In 1996, invertebrate zoology students and their professors from Samford University spotted *A. sanctaerosae* while studying nightlife on the beaches at the east end of Dauphin Island. This paper is the first description of *A. sanctaerosae* for the state of Alabama and is the product of an investigation of the ecology of this wolf spider.

METHODS

Arctosa sanctaerosae and other wolf spiders were observed on the gulf and Mississippi Sound beaches of Dauphin Island on March 19, April 17, September 11, and October 30-31, 1998 (Figure 1). Wolf spiders were located at night with the aid of Petzl Duo headlamps with incandescent and halogen bulbs. Due to a reflected bluish-green luminescence from the tapetum of their eyes, spiders as small as 3 mm could be spotted from a distance of 20 ft. Once located many of the specimens were photographed *in situ* at night with a Nikon N90S camera equipped with a 105 mm micro lens and a SB23 flash mounted to extend to the end of the lens.

Our interest centered on the specific island habitat, locations, and requirements of *A. sanctaerosae* in comparison to those of other wolf spiders. Therefore, we counted individual wolf spiders of all species at different survey stations relative to dune location (up to tertiary dune) and vegetative cover. All counts were made along stretches of sand dune 30.48 m (100 ft) parallel to the shoreline, including the entire sand dune (approximately 30 horizontal ft). Weather conditions were noted on each survey occasion for each survey station.

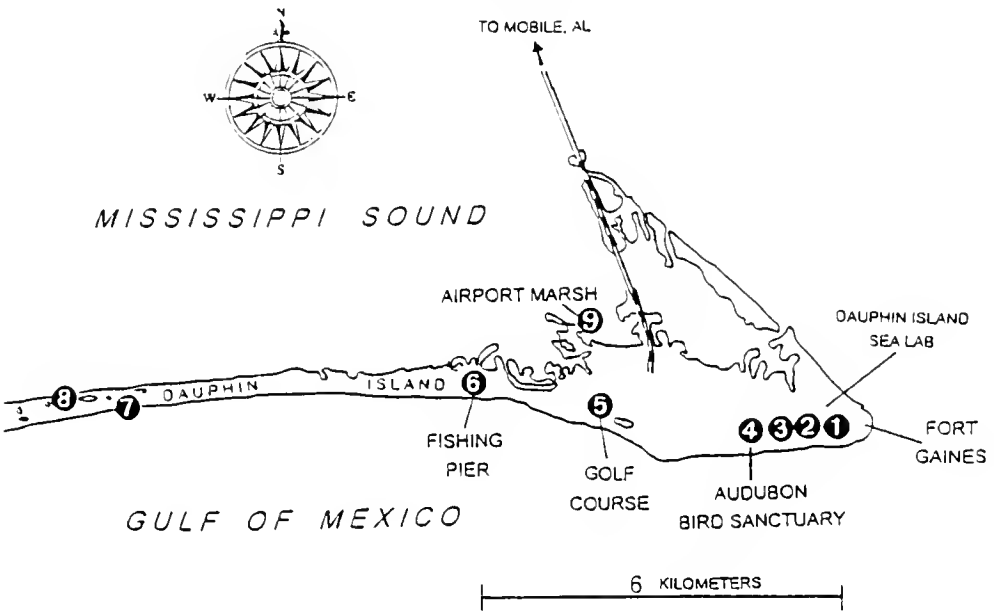


Figure 1. Map of Dauphin Island, Mobile County, Alabama and survey sites (1 to 9). The west end of the island, approximately 11 km, is not shown.

Data were statistically analyzed by ANOVA for a single criterion of classification with unequal replications. The single criterion of classification for the statistical analysis was the presence or absence of a particular spider in a certain location.

RESULTS AND DISCUSSION

Survey Sites

Based upon these observations of the beaches of Dauphin Island, the population of *A. sanctaerosae* varied considerably from one beach site to another. Of seven principal gulf beach sites surveyed, the dunes at the Audubon Sanctuary contained the greatest overall number of *A. sanctaerosae*. Combining all data without regard to weather conditions, specific dunes, or time of year, the beaches at the sanctuary contained a mean of 11 $\pm$ 9 *A. sanctaerosae* per 30.48 m of sand dune. The dunes immediately west of the DISL and at the public fishing pier also contained large populations, with means of 7 $\pm$ 2 and 9 $\pm$ 9 of *A. sanctaerosae* per 30.48 m of dune, respectively. These three sites had significantly ($p \leq 0.05$) higher counts of *A. sanctaerosae* per 30.48 m of dune than the other localities given in Figure 2.

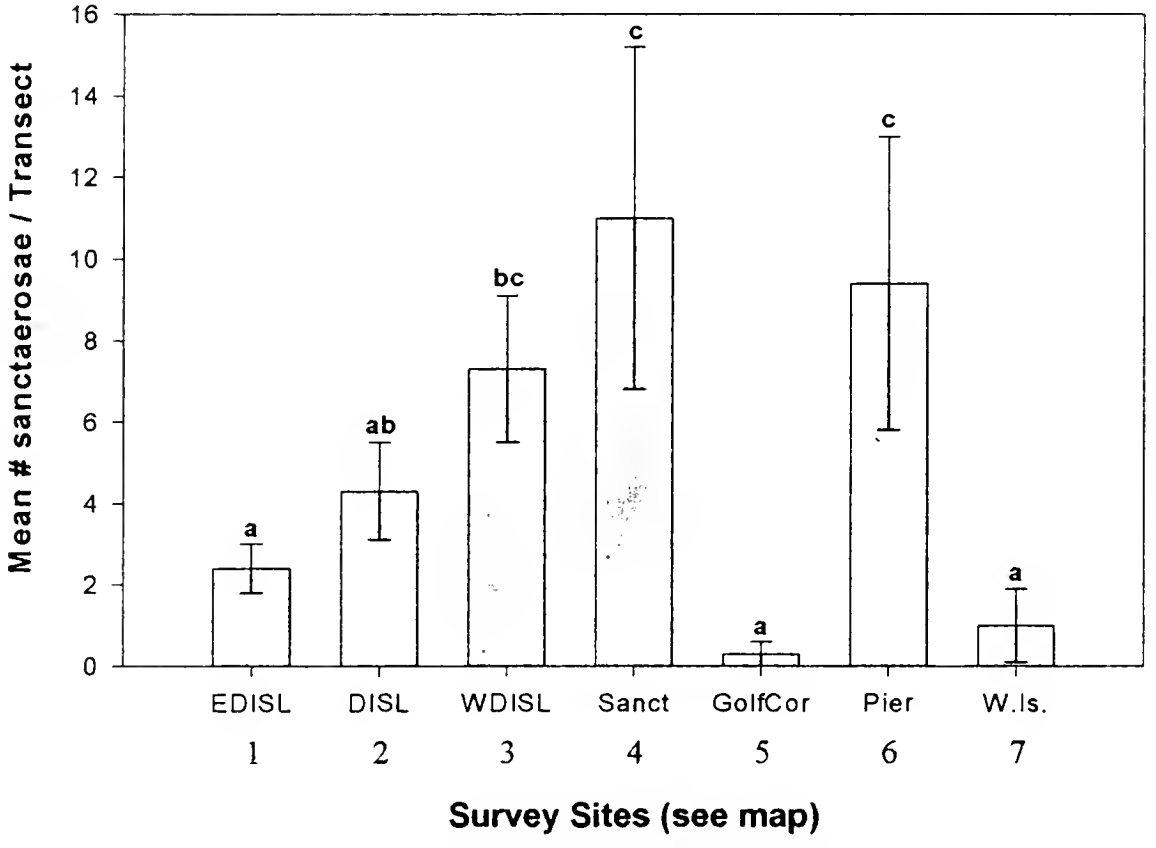


Figure 2. Mean $\pm$ SEM. of *Arctosa sanctaerosae* counted per 30.48 meters of dune at seven different gulf beach locations on Dauphin Island, AL. EDISL: east of Dauphin Island Sea Lab, DISL: Dauphin Island Sea Lab, WDISL: west of DISL, Sanct: Audubon Bird Sanctuary, GolfCor: golf course, Pier: public fishing pier, W.Is.: west end of the island. Mean number of spiders counted that are represented by different letters (a, b, c) are significantly different ($p \leq 0.05$).

Dune Locality and Vegetation

A. sanctaerosae had a preference for the secondary dune of highly structured dune systems on the beaches of Dauphin Island. Regardless of all other variables (specific beach site, weather conditions, season of the year), there was a mean number of 12.9 $\pm$ 2.8 *A. sanctaerosae* per 30.48 m of dune on secondary dunes. This was significantly greater ($p \leq$ 0.05) than the mean number of spiders counted from 30.48 m of primary dunes (3.1 $\pm$ 0.9) and tertiary dunes (4.2 $\pm$ 2.0) (Figure 3). The discovered burrows of *A. sanctaerosae* were located solely on the sandy areas of the gulf beaches and rarely covered by any vegetation. Likewise, individual specimens encountered were either in or near their burrow opening or motionless on a stark area of white sand (Figure 5).

East Versus West Island

The eastern half of Dauphin Island contains a maritime forest which extends from the Dauphin Island Sea Lab to the public fishing pier, except for the golf course. The most dense part of this forest occurs at the Audubon Bird Sanctuary. The west end of the island is

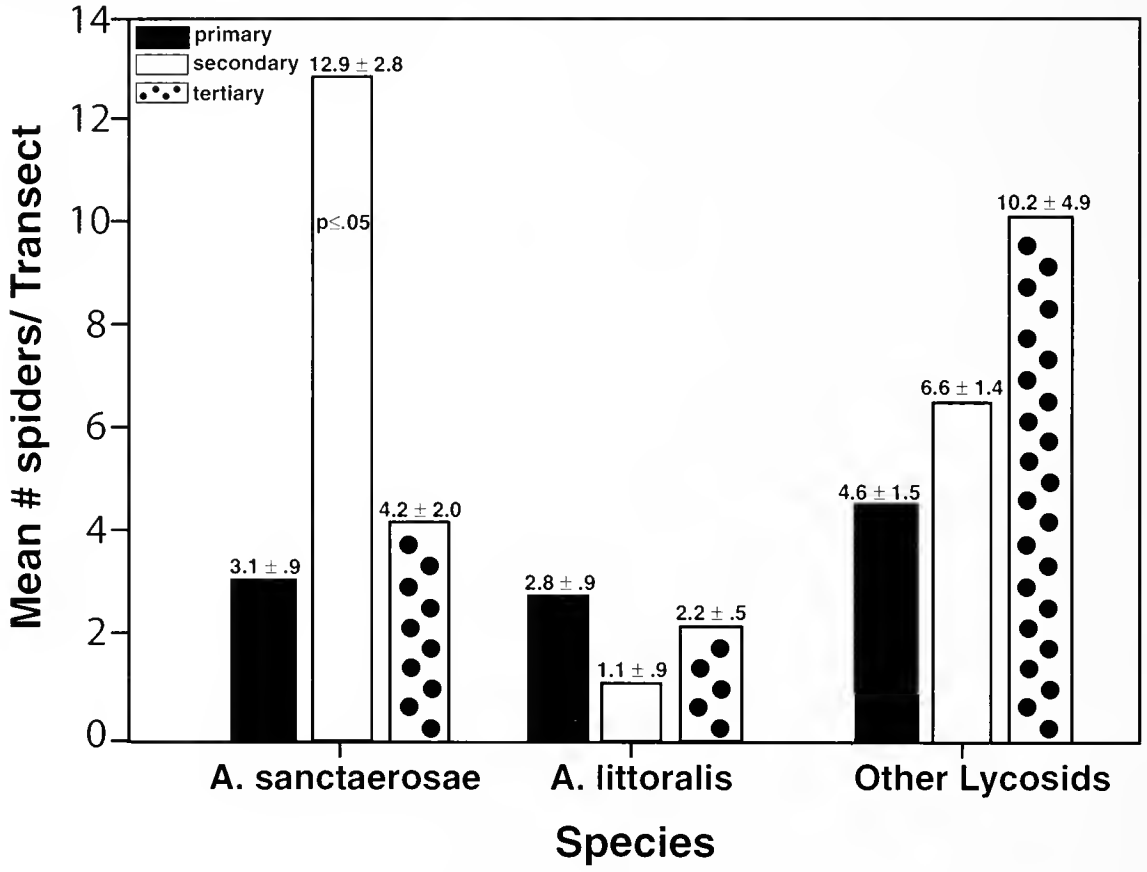


Figure 3. Mean $\pm$ SEM. of all counts of *A. sanctaerosae*, *A. littoralis*, and other species of wolf spiders per 30.48 meters of primary, secondary, or tertiary dunes (graphed in that order). Other lycosids include *Hogna carolinensis*, *Lycosa punctulata*, *Lycosa lenta*, *Lycosa baltimoriana*, and *Geolycosa escambiensis*. Significant difference is indicated between secondary dunes and primary or tertiary dunes for only *A. sanctaerosae*.

essentially a low-level sand bar covered by low scrub brush. Combining data on all dunes, the mean number of *A. sanctaerosae* counted east of the public fishing pier was 6.3 $\pm$ 1.5 spiders per 30.48 m of dune. This was significantly greater ($p \leq 0.005$) than the mean of 1.1 $\pm$ 0.2 per 30.48 m of dunes west of the public fishing pier. More *A. sanctaerosae* reside on the eastern end of the island where a maritime forest predominates.

Mississippi Sound Side of Dauphin Island

The sound side of Dauphin Island has very few sand dunes; and the dunes there are covered with vegetation. Surveys of spider populations on the bay beaches (Figure 1, site 8) at the west end of the island and at the airport (Figure 1, site 9) revealed only populations of *Arctosa littoralis* and *Hogna carolinensis*. The meager beaches of the bay side of Dauphin Island are not favorable habitats for *A. sanctaerosae*.

Weather Conditions and Other Sources of Variation

A. sanctaerosae populations were observed during spring and fall months and under varying weather conditions. The number of *A. sanctaerosae* encountered on the dunes on calm, warm evenings (Mar. 19 & Oct. 30-31, 1998) was as high as 24 spiders per 30.48 m. On the one rainy evening with temperatures below 10° C (Sept. 11, 1998), only one *A. sanctaerosae* was discovered from five sites (not all sites surveyed due to severity of weather). Of other interest is the effect Hurricane Georges (Sept. 29, 1998) had on counts of this spider. About a month after it made landfall, mean counts of *A. sanctaerosae* (secondary dune only) were as high as those for April (Figure 4).

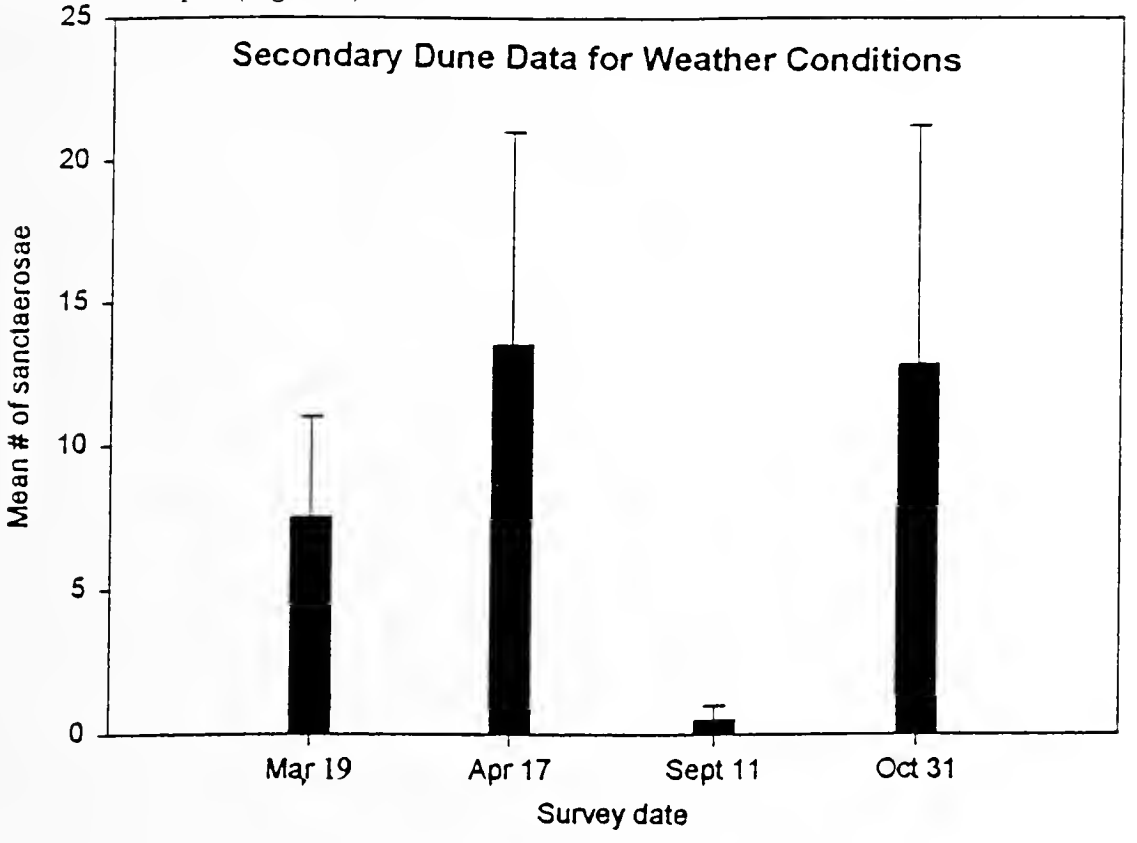


Figure 4. Mean $\pm$ SEM. secondary dune counts of *A. sanctaerosae* for each survey date.

Figure 5. Night photograph of a female *Arctosa sanctaerosae* on the sand beside the opening of her burrow.

CONCLUSION

This project reports the presence of a viable population of *A. sanctaerosae* on the beaches of Dauphin Island, Alabama. From our study we see that this spider has specific preferences for particular regions of the beaches on Dauphin Island. Where a complex dune system exists, principally on the gulf side of the island, the spider is most likely found on the secondary dunes in areas where vegetation is minimal. We believe that this is due in part to the stability of the secondary dune through bunkering by the primary and tertiary dunes, as well as anchoring by adequate amounts of vegetation. In addition, this particular dune affords the spider protection from predators by allowing it to camouflage itself. Even with vegetated areas, the secondary dune retains many expanses of white sand which help this white spider blend in with the terrain. Tidal zones and primary dunes do not provide the spider with adequate protection and dune stability, therefore, fewer *A. sanctaerosae* occur there. Fewer numbers are found to reside on the tertiary dunes as well because these dunes have maximal vegetation coverage and support more competing wolf spider species.

The largest populations of *A. sanctaerosae* occurred on the east end of the island, the locale for its only maritime forest and stretch of highly structured dune systems (gulf side). We propose that this forested area with complex dune systems was a critical factor in the exceptionally high counts of *A. sanctaerosae* recorded after Hurricane Georges. The forest provides a break from high winds and traps sand blown up by these winds, thereby helping preserve nearby dunes. In fact examination of both ends of the island on Oct. 30-31, 1998 revealed that the western end exhibited the most damage. Some thirty houses on that end were demolished and inland areas partially flooded. In the forested area between Ft. Gaines and the public fishing pier not a single house was severely damaged nor were the beaches severely eroded.

The weather condition was a determining factor in the numbers of *A. sanctaerosae* found. More spiders were encountered on calm, warm evenings. Fewer individuals, as reflected by the data in Figure 5 for the prime dune location for this spider, were found on rainy, cooler evenings (Mar. 19 & Sept. 11, 1998). Cooler temperatures and rain discouraged these nocturnal hunters from engaging in their nightly excursions.

ACKNOWLEDGMENTS

We would like to thank the following people for their help with this project: Mary Howell, Luke Roy, Colin Chisholm, Mary Albert, Christie Lowery, Tom Landry, and John Ragsdale IV. A special thanks is owed to Rose Parrino, Ben Jenkins, Anna-Lea Jenkins, Amanda Duke, and Shannon Jordan for their efforts in the field; and the Birmingham Audubon Society for the research funds that made this project possible.

LITERATURE CITED

Dondale, Charles D. and James H. Redner. 1983. Revision of the wolf spiders of the genus *Arctosa* C.L. Koch in North and Central America (Araneae: Lycosidae). *J. Arachnol.*, 11:1-30.

Gertsch, Willis J. Notes on American Lycosidae. 1935. *American Museum Novitates*, 693: 1-25.

Kaston, B. J. 1978. *How to Know the Spiders*. Wm C. Brown Publishers.

Steel, R. G. D. and J. H. Torrie. 1960. Principles and Procedures of Statistics. McGraw-Hill Book Company, Inc. New York. 481 pp.

Wallace, H. K. 1942. A revision of the burrowing spiders of the genus Geolycosa (Araneae, Lycosidae). *American Midland Naturalist*. 27:(1)1-63.

Journal of the Alabama Academy of Science, Vol. 71, No. 4, October 2000.

PTERIDOPHYTES OF NORTHEAST ALABAMA AND ADJACENT HIGHLANDS

I. ANNOTATED CHECKLIST AND KEY TO FAMILIES

Daniel D. Spaulding
Anniston Museum of Natural History
Anniston, AL 36202

R. David Whetstone
Jacksonville State University
Jacksonville, AL 36265

J. Mark Ballard
Jordan, Jones, & Goulding, Inc.
Tucker, GA 30084

INTRODUCTION

This project is a guide to all the ferns and fern allies of the northeast Alabama. Plant species occurring in adjacent highland counties are also part of this flora. The study area includes 84 specific and infraspecific taxa, representing a total of 38 genera, 18 families, 6 orders, 4 classes, and 3 divisions. Pteridophytes in our area include the following divisions: Equisetophyta, Lycopodiophyta, and Polypodiophyta. The first two divisions are the so-called fern allies, which are really not allied to the true ferns (Polypodiophyta). The guide will include illustrations, maps, identification keys, habitats, distributional data, conservation status, uses, and pertinent synonymy.

The area delineated as Northeast Alabama includes Blount, Calhoun, Cherokee, Clay, Cleburne, Cullman, DeKalb, Etowah, Jackson, Jefferson, Limestone, Madison, Marshall, Morgan, Randolph, Saint Clair, Shelby, and Talladega counties. Adjacent highland counties include Bibb, Chambers, Chilton, Coosa, Lauderdale, Lawrence, Tallapoosa, Tuscaloosa, Walker, and Winston (Figure 1). The highlands of Alabama consists of the following Provinces: Interior Low Plateau (Highland Rim), Appalachian Plateau (Cumberland Plateau), Ridge and Valley, and Piedmont Plateau (Figure 2).

Figure 1. County Map of Alabama

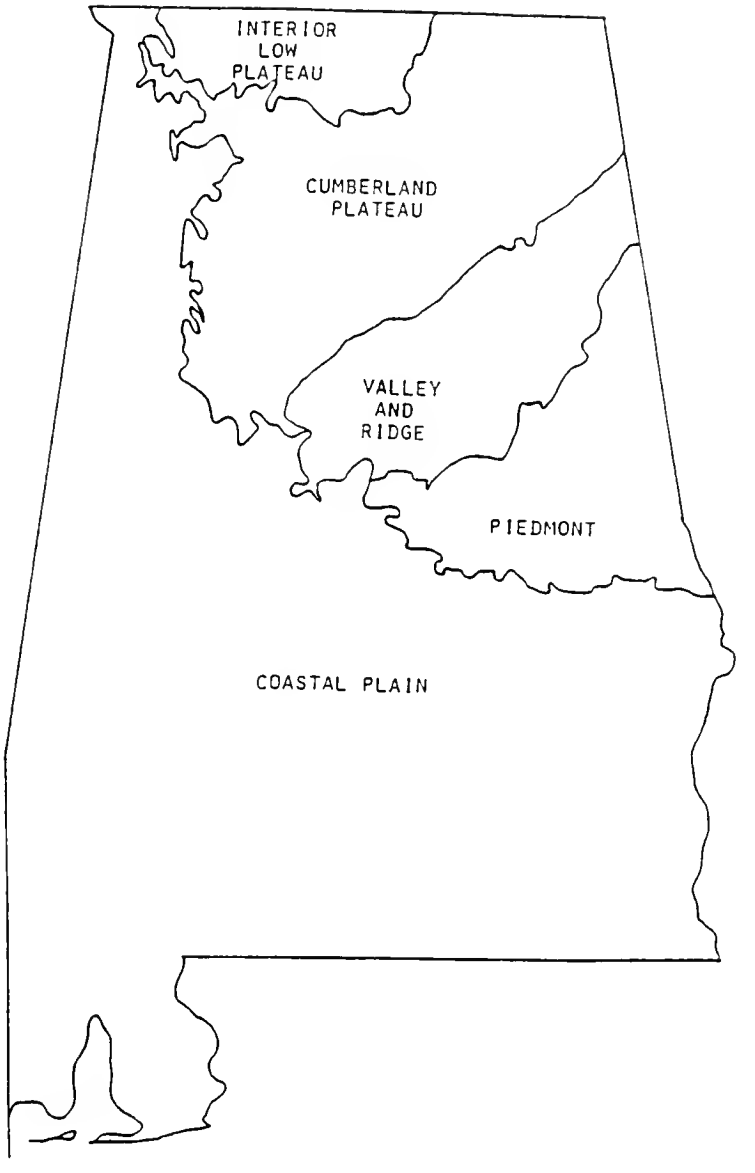


Figure 2. Physiographic map of Alabama

CHECKLIST OF PTERIDOPHYTES

Format

The checklist is based primarily upon herbarium specimens deposited at the Jacksonville State University Herbarium (JSU). The list also includes data from pertinent literature and other southeastern herbaria (Auburn University [AUA], University of Alabama [UNA], University of North Alabama [UNAF], and Vanderbilt University [VDB]). Taxa not found at JSU are noted by a herbarium acronym or literature reference. Nomenclature follows Flora of North America [FNA] (1993+) and more recent publications. Synonymy is primarily from Radford *et al.* (1968) and is italicized within brackets. Families, genera, specific and infraspecific taxa are arranged alphabetically within major vascular plant groups (divisions). Introduced taxon are followed by a dagger (†). Federal or state listed species are followed by a star (★) and their coded status designation (recent listing in plainface type; formerly listed preceded by an *x* and in *italics*). The coded ranks are defined as follows: S1, Critically Imperiled; S2, Imperiled; S3, Rare; SH, of historical occurrence; LE, Endangered Species; LT; Threatened Species. Data are from the Alabama Natural Heritage tracking and inventory lists (1994, 1996, 1997, 1999).

Annotated Checklist

DIVISION EQUISETOPHYTA

EQUISETACEAE (Horsetail Family)

Equisetum arvense L., Field Horsetail.★ S2
E. hyemale L. ssp. *affine* (Engelm.) A.A. Eaton, Scouring-rush

DIVISION LYCOPODIOPHYTA

ISOETACEAE (Quillwort Family)

Isoetes butleri Engelm., Glade Quillwort; Butler's Quillwort.★ S2
I. engelmannii A. Br., Appalachian Quillwort; Engelmann's Quillwort.★ *xS3*
I. melanopoda Gray & Durieu, Blackfoot Quillwort.★ S1? {Cherokee/VDB}
I. piedmontana (Pfeiffer) Reed, Piedmont Quillwort.★ S2

LYCOPODIACEAE (Clubmoss Family)

Diphasiastrum digitatum (Dill. *ex* A. Br.) Holub, Running Ground-pine; Ground-cedar. [*Lycopodium digitatum*; *L. flabelliforme*]
D. tristachyum (Pursh) Holub., Blue Ground-cedar; Deep-root Clubmoss ★ *xSR* [*Lycopodium tristachyum*]
Huperzia lucidula (Michx.) Trevisan, Shining Clubmoss.★ S2 [*Lycopodium lucidulum*] {Jackson/Whetstone 1981}
H. porophila (Lloyd & Underw.) Holub, Rock Clubmoss.★ S1 [*Lycopodium porophilum*] {Winston/UNA}
Lycopodiella appressa (Chapm.) Cranfill, Southern Clubmoss; Slender Clubmoss. [*Lycopodium appressum*]
L. alopecuroides (L.) Cranfill, Fox-tail Clubmoss. [*Lycopodium alopecuroides*]
Lycopodium obscurum L., Ground-pine; Tree Clubmoss.★ S1

SELAGINELLACEAE (Spikemoss Family)

Selaginella apoda (L.) Spr., Meadow Spikemoss.
S. arenicola L. spp. riddellii (Van Eselt.) Tryon, Sand Spikemoss; Riddell's Spikemoss.★ S2 [*S. riddellii*] {Shelby/VDB}
S. braunii Baker, Braun's or Treelet Spikemoss.†
S. rupestris (L.) Spring, Rock Spikemoss; Ledge Spikemoss.★ S2S3

DIVISION POLYPODIOPHYTA

ASPLENIACEAE (Spleenwort Family)

Asplenium bradleyi D.C. Eat., Cliff Spleenwort; Bradley's Spleenwort.★ S2
A. x *ebenoides* Scott, Scott's Spleenwort.★ S1 [*A. platyneuron x A. rhizophyllum*] {Jefferson/Whetstone 1981}

A. x *gravesii* Maxon, Graves' Spleenwort. [*A. bradleyi* x *A. pinnatifidum*] {Jackson, DeKalb & Etowah/Short 1978}
A. monanthes L., Single-sorus Spleenwort.★ S1 {Jackson & Talladega/VDB}
A. montanum Willd., Mountain Spleenwort.
A. pinnatifidum Nutt., Lobed Spleenwort.
A. platyneuron (L.) Oakes, Ebony Spleenwort.
A. resiliens Kunze, Blackstem Spleenwort.
A. rhizophyllum L., Walking Fern. [*Camptosorus rhizophyllus*]
A. ruta-muraria L., Wall-rue Spleenwort.★ S2 {Etowah/UNA}
A. scolopendrium L. var. *americanum* (Fern.) Kartesz & Gandhi, Hart's-tongue Fern.★ S1/LT [*Phyllitis scolopendrium* var. *americanum*]
A. trichomanes L., Maidenhair Speenwort.★S2S3 *xS1*
A. x *trudellii* Wherry, Trudell's Spleenwort. [*A. montanum* x *A. pinnatifidum*] {Jackson & Etowah/Short 1978}

AZOLLACEAE (Mosquito Fern Family)

Azolla caroliniana Willd., Mosquito Fern.

BLECHNACEAE (Chain Fern Family)

Woodwardia areolata (L.) Moore, Netted Chain fern; Net-veined Chain Fern. [*Lorinseria areolata*]
W. virginica (L.) Smith, Virginia Chain Fern; Southern Chain Fern.

DENNSTAEDTIACEAE (Cuplet Fern Family)

Dennstaedtia punctilobula (Michx.) T. Moore, Hay-scented Fern; Boulder Fern.★ *xS3*
Pteridium aquilinum (L.) Kuhn var. *latiusculum* (Desv.) Underw., Eastern Bracken Fern.
P. a. var. pseudocaudatum (Clute) Heller, Southern Bracken Fern; Tailed Bracken Fern.

DRYOPTERIDACEAE (Wood Fern Family)

Athyrium filix-femina (L.) Roth var. *asplenioides* (Michx.) Farw., Southern Lady Fern; Lowland Lady Fern. [*A. asplenioides*]
Cystopteris bulbifera (L.) Bern., Bulblet Bladder Fern; Berry Bladder Fern.★ *xS?*
C. protrusa (Weath.) Blasdell, Spreading Bladder Fern; Lowland Bladder Fern. [*C. fragilis* var. *protrusa*]
C. tennesseensis Sh., Tennessee Bladder Fern.★S2
Deparia acrostichoides (Sw.) Kato, Silvery Glade Fern. [*Athyrium thelypteroides*]
Diplazium pycnocarpon (Spreng.) M. Broun, Glade Fern. [*Athyrium pycnocarpon*]
Dryopteris x *australis* (Wherry) Small, Southern Wood Fern.★ S1
D. celsa (Palmer) Knowlton, Log Fern.★ S1
D. intermedia (Muhl.) Gray, Fancy Fern; Evergreen Wood Fern.
D. marginalis (L.) Gray, Marginal Shield Fern; Leather Wood Fern.
Onoclea sensibilis L., Sensitive Fern; Bead Fern.
Polystichum acrostichoides (Michx.) Schott, Christmas Fern.
Woodsia obtusa (Spreng.) Torr., Blunt-lobed Cliff-fern; Common Woodsia.

HYMENOPHYLLACEAE (Filmy Fern Family)

Hymenophyllum tayloriae Farrar & Raine, Taylor's Filmy Fern; Gorge Filmy Fern.★ S1 {Lawrence & Winston/UNAF}
Trichomanes boschianum Sturm, Bristle Fern; Filmy Fern.★ *xS3*
T. intricatum Farrar, Weft Fern.
T. petersii Gray, Dwarf Filmy Fern; Peter's Bristle Fern.★ S2

LYGODIACEAE (Climbing Fern Family)

Lygodium palmatum (Bernh.) Sw., American Climbing Fern.★ *S2? xS1*
L. japonicum (Thunb.) Sw., Japanese Climbing Fern.†

MARSILEACEAE (Water-clover Family

Pilularia americana Braun, Pillwort.★ S1 {Lauderdale/UNAF}

OPHIOGLOSSACEAE (Adder's-tongue Family)

Botrychium biternatum (Savigny) Underw., Southern Grapefern.
B. dissectum Spreng., Cut-leaf Grapefern; Common Grapefern. [*B. d.* var. *obliquum*]
B. jenmanii Underw., Alabama Grapefern.★ SH {DeKalb/Dean 1968}[*B. alabamense*]
B. lunarioides (Michx.) Sw., Winter Grapefern.★ SH {Morgan/AUA}
B. virginianum (L.) Sw., Rattlesnake Fern; Virginia Grapefern.
Ophioglossum engelmannii Prantl, Limestone Adder's-tongue.★ S2S3
O. crotalophoroides Walt., Bulbous Adder's-tongue.★ *xS3*
O. vulgatum L., Common Adder's-tongue. [*O. v.* var. *pycnostichum*]

OSMUNDACEAE (Royal Fern Family)

Osmunda cinnamomea L., Cinnamon Fern.
O. regalis L. var. *spectabilis* (Willd.) Gray, Royal Fern.

POLYPODIACEAE (Polypody Family)

Pleopeltis polypodioides (L.) Andr. & Wind. var. *michauxiana* (Weatherby) Andr. & Wind. Resurrection Fern; Gray Polypody. [*Polypodium polypodioides*]

Polypodium virginianum L., Rockcap Fern; Common Polypody. [Inc. *P. appalachianum*]

PTERIDACEAE (Maidenhair Fern Family)

Adiantum capillus-veneris L., Southern Maidenhair Fern; Venus'-hair Fern.
A. pedatum L., Common Maidenhair Fern; Northern Maidenhair Fern.
Astrolepis integerrima (Hook.) Benh. & Wind., False Cloak Fern; Star-scaled Cloak Fern.★S1 [*Notholaena integerrima*]{Bibb/Allison 1996}
Cheilanthes alabamensis (Buckl.) Kunze, Alabama Lip Fern.★ *xS3*
C. lanosa (Michx.) D.C. Eat., Hairy Lip Fern.
C. tomentosa Link, Woolly Lip Fern.
Pellaea atropurpurea (L.) Link, Purple Cliff-brake.
Pteris multifida Poir. *ex* Lam., Spider Brake; Wall Fern.†

THELYPTERIDACEAE (Marsh Fern Family)

Macrothelypteris torresiana (Gaud.-Beaup.) Ching, Mariana Maiden Fern.† [*Thelypteris torresiana*]
Phegopteris hexagonoptera (Michx.) Fee, Broad Beech Fern. [*Thelypteris hexagonoptera*]
Thelypteris kunthii (Desv.) Morton, Widespread Maiden Fern; Southern Shield Fern.
T. noveboracensis (L.) Nieuwl., New York Fern.
T. ovata R. St. John, Ovate Maiden Fern.★ S3 {Bibb/Allison 1996}
T. palustris Schott var. pubescens (Lawson) Fern., Marsh Fern.
T. pilosa (Mart. & Gale) Crawf. var. alabamensis Crawf., Alabama Streak-sorus Fern.★ S1/LT [*Leptogramma pilosa* var. *americana*]{Winston}

VITTARIACEAE (Shoestring Fern Family)

Vittaria appalachiana Farrar & Mickel, Appalachian Shoestring Fern.

KEY TO PTERIDOPHYTE FAMILIES

1. Plant floating on water or stranded on moist substrate (not rooted in soil) . . . . . Azollaceae
1. Plant rooting in soil or growing on trees or rocks.
   2. Plant with gametophyte generation only, lacking sporangia; plant filamentous or resembling a liverwort; growing in non-calcareous rock crevices.
      3. Plant filamentous or ribbon-like . . . . . Hymenophyllaceae (in part)
      3. Plant leaf-like, not filamentous or ribbon-like . . . . . Vittariaceae
   2. Plant with sporophyte generation; plant not filamentous or not resembling a liverwort; habitat various.
      4. Stems hollow, jointed, and ridged; leaves inconspicuous and sheathed around stem; sporangia in cone-like strobili terminating stem . . . . . Equisetaceae
      4. Stems not hollow, non-jointed, and lacking ridges; leaves conspicuous and not forming sheaths around stem; sporangia variously borne.
         5. Plant grass-like; sporangia borne at leaf base.
            6. Plant tufted; sporangia enclosed in a cavity at leaf base . . . . Isoetaceae
            6. Plant on short creeping stems, not tufted; sporangia numerous in a sporocarp attached by short stalk (1-3 mm) at base of leaf . . . . . Marsileaceae (*Pilularia*)
         5. Plant not grass-like; sporangia variously borne on leaf surfaces.
            7. Plant moss-like; leaves simple and greatly reduced; blades bearing a single midvein or midveins wanting; sporangia in axils of leaves or in cone-like strobili.
               8. Leaves tightly appressed (imbricate) and scale-like.
                  9. Plant more than 5 cm tall; strobili cylindric and on branching slender stalks or sessile . . . . Lycopodiaceae (*Diphasiastrum*)
                  9. Plant less than 5 cm tall; strobili quadrangular (4 sided) and sessile . . . . . Selaginellaceae (in part)
               8. Leaves spreading or loosely appressed, not scale-like.
                  10. Leaves dimorphic, of two different shapes and sizes (lateral and median leaves); strobili quadrangular . . . . . Selaginellaceae (in part)
                  10. Leaves not dimorphic, all of similar sizes; strobili cylindric or sporangia solitary in axils of leaves . . Lycopodiaceae (in part)
            7. Plant not moss-like; leaves often large and elaborate, simple or compound; blades with numerous lateral veins; sporangia usually borne on leaf surfaces, not in leaf axils or in cone-like strobili.
               11. Plant vine-like, twining, and usually climbing on vegetation . . . . . Lygodiaceae
               11. Plant not vine-like and not climbing on vegetation.
                  12. Leaves not deeply lobed or dissected.

13. Sporangia borne on a separate fertile, spike-like sporophore, usually arising from a single leaf (occasionally 2 or more leaves in some species) . . . . . Ophioglossaceae (in part)
13. Sporangia borne on the underside (abaxial surface) or margin of leaf, not on a sporophore.
    14. Leaves less than 3 cm long, very thin and translucent (1 cell thick) . . . . . Hymenophyllaceae (in part)
    14. Leaves more than 3 cm long, thicker and not transparent (2 or more cells thick) . . . . . Aspleniaceae (in part)

12. Leaves deeply lobed to dissected.
    15. Blades on sterile (non-sporulating) leaves, 1-pinnatifid (sometimes pinnate at base).
        16. Leaves monomorphic, sterile and fertile (sporulating) leaves similar in appearance and both pinnatifid (deeply lobed); leaves evergreen.
            17. Sori round and without indusia (a protective covering); leaf stalk (petiole) green . . . . . Polypodiaceae
            17. Sori elongate with indusia; leaf stalk brown, at least near base . . . . . Aspleniaceae (in part)
        16. Leaves dimorphic, fertile (sporulating) leaves greatly dissimilar to sterile (non-sporulating) leaves, only sterile ones pinnatifid; leaves not evergreen.
            18. Sterile leaves with mostly with opposite pinnae, margins undulating to lobed; fertile leaves forming bead-like clusters . . . Dryopteridaceae (*Onoclea*)
            18. Sterile leaves mostly with alternately arranged pinnae, margins with small teeth (serrulate); fertile leaves pinnate, not forming bead-like clusters . . . . . Blechnaceae (in part)
    15. Blades on non-sporulating leaves 2-pinnatifid, pinnate or more than 1- pinnate.
        19. Sporangia borne on branched fertile segments ("spikes") arising from a single leaf . . Ophioglossaceae (in part)
        19. Sporangia borne on underside or margin of leaf, not on branched fertile segments.
            20. Sterile and fertile leaves or leaflets strongly dimorphic; fertile portions lacking leafy tissue; flat stipules present at base of leaves; sporangia without well defined annulus (row of thick-walled cells) . . . . . Osmundaceae
            20. Sterile and fertile leaves similar or only slightly dimorphic; fertile portions with leafy tissue; stipules

lacking at leaf bases; sporangia with well developed annulus.

21. Leaves thin and translucent (1 cell thick between veins); leaf blades usually less than 20 cm long; sporangia borne along margins of leaflets in a tubular cup-like structure (involucre) with an exserted bristle; plant growing on acidic rock (e.g., sandstone) . . . . . Hymenophyllaceae (in part)

21. Leaves much thicker; sporangia borne on the underside (abaxial surface) or margins of leaflets, but not in an involucre with an exserted bristle; plants growing in soil or on various types of rock (basic or acidic).

    22. Sori located along margins of leaflets, either covered by rolled under (revolute) leaflet edge or in cup-like indusia.

        23. Sori in cup-like indusia and not covered by edge of leaflets; leaf blades and rachises bearing gland-tipped whitish hairs (with a hay-like fragrance); rhizome hairy . . . . . Dennstaedtiaceae (*Dennstaedtia*)

        23. Sori covered by rolled under leaflet edge; leaf blades glabrous or pubesecnt, but lacking white gland-tipped hairs; rhizome scaly or hairy.

            24. Leaf stalk 3-branched; leaves (3 main divisions) broadly triangular; rhizome hairy . . . . . Dennstaedtiaceae (*Pteridium*)

            24. Leaf stalk not 3-branched; leaves not broadly triangular; rhizome scaly. . . . . Pteridaceae

    22. Sori not located along the edge of leaflets, or sori marginal with kidney-shaped indusium and not covered by rolled under leaflet edge.

        25. Veins areolate along mid-veins of leaflets, forming a series of chain-like loops; sori elongate and located along each side of mid-vein in single chain-like rows . . . . . Blechnaceae (in part)

        25. Veins of leaflet not areolate; sori round or elongate and located along lateral veins

and mid-veins of leaflets, but not in single end to end rows.

26. Leaves small to medium-sized (less than 12 cm wide) and evergreen; leaf stalks (petioles) wiry; sori elongate bordering veins only along one side (except in *Thelypteris pilosa*).
    27. Leaves with transparent, needle-like (pointed-tipped) hairs; sori lacking indusia; plant known only from Winston County growing on sandstone cliffs . . . . Thelypteridaceae (*T. pilosa*)
    27. Leaves lacking transparent, needle-like hairs (hairs have blunt tips, if present); sori with indusia; plants widespread in various habitats . . . . . Aspleniaceae (in part)
26. Leaves large (more than 12 cm wide end deciduous; leaf stalks stout, sori round or elongate and usually partially covering veins.
    28. Leaves with transparent, needle-like (pointed-tipped) hairs that are simple to branched; sori with or without indusium; rhizome creeping (mostly subterranean) and slender, less than 1 cm in diameter . . . . . Thelypteridaceae (in part)
    28. Leaves with blunt-tipped, simple hairs (not transparent or needle-like) hairs (or leaves glabrous); sori with indusium; rhizome ascending and thicker, more than 1 cm in diameter . . . . . Dryopteridaceae (in part)

ACKNOWLEDGMENTS

We are especially grateful to the late Warren Herb Wagner, Jr. who thoroughly reviewed this flora. He was a magnificent botanist who inspired us with his zeal. Special thanks goes out to Robert Kral for his many comments and suggestions. He is the authority on Alabama plants and his review made this flora complete. We also thank Jack Short for reading through the manuscript and providing valuable insight. The grammatical review of Verna Gates of Birmingham greatly improved this work. We thank Marion Montgomery, of the Anniston Museum of Natural History, who painstakingly drew the original illustrations. Finally, we appreciate the contributions of Terri Ballard (Equisetaceae, Ophioglossaceae, Lygodiaceae), Tim Hofmann (Dennstaedtiaceae), and Steve Threlkeld (*Adiantum*).

REFERENCES CITED

Alabama Natural Heritage Program [ANHP]. 1994. Vascular Plant Inventory Tracking List, April edition. Montgomery, Alabama.

Alabama Natural Heritage Program. 1996. Species Inventory List. Montgomery, Alabama.

Alabama Natural Heritage Program. 1997. Inventory List of Rare, Threatened, and Endangered Plants, Animals, and Natural Communities of Alabama. Montgomery, Alabama.

Alabama Natural Heritage Program. 1999. Inventory List of Rare, Threatened, and Endangered Plants, Animals, and Natural Communities of Alabama. Montgomery, Alabama.

Allison, J. R. 1996. A "lost world" in Bibb County, Alabama. Georgia Department of Natural Resources, Georgia Natural Heritage Program.

Dean, B. E. 1968. Ferns of Alabama. Southern University Press, Birmingham.

Flora of North America [FNA] Editorial Committee, eds. 1993+. Flora of North America North of Mexico. 4+ vols. New York and Oxford.

Radford, A. E., H. E. Ahles and C. R. Bell. 1968. Manual of the Vascular Flora of the Carolinas. The University of North Carolina Press, Chapel Hill.

Short, J. W. 1978. Distribution of Alabama Pteridophytes. M.S. Thesis, Auburn University, Auburn.

Whetstone, R. D. 1981. Vascular flora and Vegetation of the Cumberland Plateau of Alabama... Ph.D. Dissertation, Department of Botany, University of North Carolina at Chapel Hill.

Journal of the Alabama Academy of Science, Vol. 71, No. 4, October 2000.

PTERIDOPHYTES OF NORTHEAST ALABAMA AND ADJACENT HIGHLANDS

II. EQUISETOPHYTA AND LYCOPODIOPHYTA

Daniel D. Spaulding
Anniston Museum of Natural History
Anniston, AL 36202

J. Mark Ballard
Jordan, Jones, & Goulding, Inc.
Tucker, GA 30084

R. David Whetstone
Jacksonville State University
Jacksonville, AL 36265

Illustrated by:
Marion Montgomery
Anniston Museum of Natural History
Anniston, AL 36202

INTRODUCTION

The divisions covered in this work are Equisetophyta and Lycopodiophyta, which include horsetails, scouring-rushes, quillworts, club-mosses, and spike-mosses. These "fern allies," produce spores like the true ferns (division Polypodiophyta), but look more like mosses, grasses, or rushes. The leaves of fern allies also lack a leafstalk (petiole) and the leaves are small (except in quillworts) and veinless or with only a single unbranched vein.

Information on specific and infraspecific taxa is set up in the following format: **Number.** ***Name*** author(s) [derivation of specific and infraspecific epithets]. VERNACULAR NAME. Habit; nativity (if exotic). Sporulating dates. Habitat data; highland provinces; relative abundance; [occurrence on Coastal Plain]. Conservation status. Wetland indicator status. Comments. *Synonyms*.

Introduced taxa are followed by a dagger (†). Species of conservation concern are followed by a star (★). The coded state ranks (ANHP 1994, 1996, 1997, 1999) are defined in Table 1. Wetland indicator status codes (Reed 1988) are defined in Table 2. Relative abundance is for occurrence in the study area and not for the whole state. Frequency of occurrence is defined as followed, ranging in descending order: common (occurring in

abundance throughout), frequent (occurring throughout but not abundant), occassional (known in more than 50% of the region but in scattered localities), infrequent (known in less than 50% of the region in scattered localities), rare (known from only a few counties and restricted to a specific localities), and very rare (known from only a single or few populations; mostly narrow endemics, disjuncts, and peripheral taxa). Synonyms are from Mohr (1901)— M; Small (1938)— S; Radford *et al.* (1968)— R; and Lellinger (1985)— L. Suggested pronunciation, author(s), date of citation, common name, and derivations are provided after each genus.

Distribution maps are typically for 18 counties in the northeast region of Alabama. The maps are expanded to adjacent highland counties for taxa that are rare or peripheral. Key to symbols are as follows: Filled circle (•) = documented at Jacksonville State University herbarium; filled square (■) = documented at another herbarium; open circle (○) = reported in literature.

Table 1. Definition of state ranks.

Code	Definition
S1	*Critically imperiled* in Alabama because of extreme rarity or because of some factor(s) making it especially vulnerable to extirpation from Alabama.
S2	*Imperiled* in Alabama because of rarity or because of some factor(s) making it very vulnerable to extirpation from the state.
S3	*Rare or uncommon* in Alabama.
S4	*Apparently secure* in Alabama, with many occurrences.
S5	*Demonstrably secure* in Alabama and essentially "ineradicable" under present conditions.
SH	*Of historical occurrence*, perhaps not verified in the past 20 years, and suspected to be still extant.
SR	*Reported*, but without persuasive documentation which would provide a basis for either accepting or rejecting the report.
SU	*Possibly in peril* in Alabama, but status uncertain.
S?	*Not ranked* to date.

Table 2. Definition of wetland indicator codes.

Code	Status	Probability of Occurrence
OBL	Obligate Wetland Species	Occurs with estimated 99% probability in wetlands.
FACW	Facultative Wetland Species	Estimated 67%-99% probability of occurrence in wetlands, 1%- 33% probability in nonwetlands.
FAC	Facultative Species	Equally likely to occur in wetlands and nonwetlands (34%-66% probability).
FACU	Facultative Upland Species	Estimated 67%-99% probability of occurrence in nonwetlands, 1%-33% probability in wetlands.
UPL	Obligate Upland Species	Occurs with estimated 99% probability in uplands.
NI	No Indicator Status	Insufficient information available to determine an indicator status.

Positive or negative signs indicate a frequency toward higher (+) or lower (-) frequency of occurrence within a category.

Division I. EQUISETOPHYTA
Class 1. EQUISETOPSIDA
Order 1. EQUISETALES

1. EQUISETACEAE (Horsetail Family)*

*Contributed in part by Terri L. Ballard

1. EQUISETUM {eh-quih-SEE-tum} Linnaeus 1753 • Horsetails • [Latin *equus*, horse, and *seta*, bristle; the bushy, branching pattern in some species somewhat resemble a horse's tail.]

Selected references: Hauke, R. L. 1961. A resume of the taxonomic reorganization of *Equisetum*, subgenus *Hippochaete*, I. Amer. Fern J. 52: 29-123. Hauke, R. L. 1962. A resume of the taxonomic reorganization of *Equisetum*, subgenus *Hippochaete*, III. Amer. Fern J. 52: 57-63. Hauke, R. L. 1993. Equisetaceae. In: Flora of North America Editorial

Committee, eds. 1993+. Flora of North America North of Mexico. 3+ vols. New York and Oxford. Vol. 2, pp. 76-84.

1. Stems dimorphic; sterile (non-sporulating) stems green (chlorophyllus) with whorls of branches at node; fertile (sporulating) stems brownish (achlorophyllus) unbranched; dark bands not present above or below nodal sheaths; strobili ("cones") 1-3 cm long, stalks 2-5 cm long, apex rounded, maturing early spring before sterile stems; aerial stems annual, flexuous . . . . . *E. arvense*
1. Stems monomorphic: both fertile and sterile stems green and unbranched; dark bands present above and/or below nodal sheaths; strobili 0.5-1.5 cm long, stalks sessile to subsessile, apex mucronate, maturing late spring through summer; aerial stems evergreen, rigid . . . . . *E. hyemale*

1. ***Equisetum arvense*** ★ Linnaeus [of cultivated fields]. FIELD HORSETAIL. Figure 1. Deciduous perennial. Sporulates March - April. Low open woods and seepy areas; Cumberland Plateau, Ridge and Valley; rare; [Coastal Plain]. State Rank, S2. Wetland Indicator Status, FAC. It is only known from two places in northern Alabama; near Willett Spring in Calhoun County and Hughes Spring in Morgan County. Further south, it has been found growing on the banks of the Black Warrior River in Greene and Marengo counties. This species also occurs in Europe where the juice of the plant mixed with vinegar has been used as a remedy for ulcers and dropsy (Abbe 1981).

2. ***Equisetum hyemale*** Linnaeus [of winter] subsp. ***affine*** (Engelmann) Calder & Taylor [allied]. COMMON SCOURING-RUSH; TALL SCOURING-RUSH. Figure 2. Evergreen perennial. Sporulates May - September. Low woods, streambanks, seepages, and pond margins; Interior Low Plateau, Cumberland Plateau, Ridge & Valley; occasional; [rarely Coastal Plain]. Wetland Indicator Status, FAC+. *Equisetum hyemale* occurs in Europe and Asia to northwestern China. The specific epithet is referring to the fact that this species persists throughout winter (Thieret 1980). *Equisetum* is considered poisonous to horses and other livestock when consumed with hay (Pohl 1955). Because of the hard sand-like substance (silica) found in the plant, the rush-like stems were used to polish pewter, scrub floors, and scour pots, pans and other utensils (Abbe 1981), hence the common names. The high silica content makes it a folk remedy for arthritis; the theory is silica smooths joints. Synonyms: *Equisetum praealtum* Rafinesque— S; *Equisetum hyemale* Linnaeus var. *affine* (Engelmann) A. Eaton— L.

DIVISION II. LYCOPODIOPHYTA
Class 1. ISOËTOPSIDA
Order 1. ISOËTALES

1. ISOËTACEAE (Quillwort Family)

1. ISOËTES {eye-so-EE-teez} Linnaeus 1753 • Quillworts • [Greek *isos*, equal, and *etos*, year; in reference to evergreen habit of some members of this genus.]

Selected references: Boom, B. M. 1982. Synopsis of *Isoëtes* in the southeastern United States. Castanea 47: 38–59. Brunton, D. F., D. M. Britton, and T. F. Wieboldt. 1996. Taxonomy, identity, and status of *Isoëtes virginica* (Isoëtaceae). Castanea 61: 145–160. Taylor, W. C., N. T. Luebke, D. M. Britton, R. J. Hickey, and D. F. Brunton. 1993. *Isoëtes*. In: Flora of North America Editorial Committee, eds. 1993+. Flora of North America North of Mexico. 3+ vols. New York and Oxford. Vol. 2, pp. 64–75. Taylor, W. C., T. H. Mohlenbrock, and J. A. Murphy. 1975. The spores and taxonomy of *Isoëtes butleri* and *I. melanopoda*. Amer. Fern J. 65: 33–38.

1. Sporangium wall whitish (unpigmented); megaspores with honeycomb-like ridges (reticulate); plant aquatic (submerged or emergent), usually not associated with rock outcrops . . . . . *I. engelmannii*
1. Sporangium wall pigmented with brown; megaspores with short ridges, wart-like projections (tuberculate to papillate) or almost smooth; plant terrestrial or amphibious in wet clay soils or on rock outcrops.
   2. Plant of granite outcrops (rarely sandstone); sporangium brown and less than 6 mm long . . . . . *I. piedmontana*
   2. Plant of limestone outcrops or prairie-like habitats; sporangium mottled with brown and usually more than 6 mm long.
      3. Leaf bases pale to brown; leaves usually less than 1 mm wide at middle; megaspores papillate, more than 450 *u*m in diameter (0.50–0.65 mm average); plant of limestone outcrops . . . . . *I. butleri*
      3. Leaf bases usually shiny black; leaves usually more than 1 mm wide at middle; megaspores almost smooth to slightly tuberculate, less than 450 *u*m in diameter (0.30–0.40 mm average); plant not associated with limestone outcrops . . . . . *I. melanopoda*

1. ***Isoëtes butleri*** ★ Engelmann [G. D. Butler, 1850–1910]. BUTLER'S QUILLWORT; GLADE QUILLWORT. Figure 3. Deciduous perennial. Sporulates April – October. Limestone outcrops; Interior Low Plateau, Cumberland Plateau; rare. State Rank, S2. Wetland Indicator Status, OBL. Named in 1878 by George Engelmann in honor of its discoverer, George Dexter Butler.

2. ***Isoëtes engelmannii*** ★ A. Braun [G. Engelmann, 1809–1884]. ENGELMANN'S QUILLWORT. Figure 4. Evergreen perennial. Sporulates April – October. Small streams, ponds, pools, and ditches; all highland provinces; infrequent; [Coastal Plain]. State Rank, previously S3 (ANHP 1994). Wetland Indicator Status, OBL. The most widely distributed quillwort in North America. Species was discovered in 1842 near St. Louis by George Engelmann, it was named in his honor by Alexander Braun. A recently described species, *Isoëtes appalachiana* Brunton & Britton (Appalachian Quillwort) is very similar to *I. engelmanni* and occurs in Georgia and other states. It has a distinct cytology and spore morphology: *I. appalachiana* is tetraploid and its megaspores have a broken-reticulate pattern with ragged-crests; *I. engelmannni* is hexaploid and its megaspores have an unbroken reticulate pattern with generally smooth crests (Brunton and Britton 1997).

3. ***Isoëtes melanopoda*** ★ Gray & Durieu [black-footed]. BLACK-FOOTED QUILLWORT; MIDLAND QUILLWORT. Figure 5. Deciduous perennial. Sporulates April - October. Wetland Indicator Status, OBL. Wet fields and prairies; Interior Low Plateau, Ridge and Valley; rare. State Rank, S1. The specific epithet means "black-foot" referring to the leaf bases, though they are not always black.

4. ***Isoëtes piedmontana*** ★ (N. E. Pfeiffer) C. F. Reed [of the Piedmont]. PIEDMONT QUILLWORT; BLACK-BASED QUILLWORT. Figure 6. Deciduous perennial. Sporulates April - October. Granite outcrops on the Piedmont Plateau; rare; very rarely sandstone outcrops on the Cumberland Plateau. State Rank, S2. Wetland Indicator Status, OBL. Found only in Alabama, Georgia, and South Carolina. Another granite outcrop species, the Black-spored Quillwort (*I. melanospora* Engelmann) was erroneously reported for Alabama. It can be distinguished from *I. piedmontana* by its blackish spores, leaves that are usually less than 8 cm long, and unpigmented sporangium wall.

Order 2. SELAGINELLALES

1. SELAGINELLACEAE (Spike-moss Family)

1. SELAGINELLA {sell-lah-jih-NELL-uh} Palisot de Beauvois 1805 • Spike-mosses • [*Selago*, an ancient name for *Lycopodium*, a genus resembling *Selaginella*, and Latin *-ella*, diminutive suffix.]

Selected references: Valdespino, I. O. 1993. *Selaginella*. In: Flora of North America Editorial Committee, eds. 1993+. Flora of North America North of Mexico. 3+ vols. New York and Oxford. Vol 2, pp. 38–63. Van Eseltine, G. P. 1918. The allies of *Selaginella rupestris* in the southeastern United States. Contr. Nat. Herb. 20: 159–172.

1. Sterile leaves dimorphic; arranged in 4 ranks on stem (2 medial, 2 lateral); lateral leaves appressed to stem.
   2. Plant erect; large aerial branches above main stem; plant of moist areas (usually in close association with original ornamental planting) . . . . . *S. braunii*
   2. Plant prostrate; branching along length of main stem; plant of wet rocks, creek banks, and low wet areas where species occurs naturally . . . . . *S. apoda*
1. Sterile leaves monomorphic; no distinct arrangement on stem.
   3. Stems erect or ascending (seldom decumbent or creeping); roots usually well developed; megaspores with honey-combed surfaces . . . . . *S. arenicola* subsp. *riddellii*
   3. Stems decumbent or creeping (never erect); roots few to non-existent; megaspores nearly smooth . . . . . *S. rupestris*

1. ***Selaginella apoda*** (Linnaeus) Spring [footless]. MEADOW SPIKE-MOSS. Figure 7. Deciduous perennial. Sporulates May - September. Creek banks, sheltered wet areas, moist sandstone bluffs, and low wet areas; all highland provinces; frequent; [Coastal Plain].

Wetland Indicator Status, FACW+. The specific epithet refers to the lack of a well developed creeping rootsystem; thus the plant is "footless" (Snyder and Bruce 1986). Synonyms: *Selaginella apus* (Linnaeus) Spring— M; *Diplostachyum apodum* (Linnaeus) Beauvois—S.

2. ***Selaginella arenicola*** ★ L. Underwood [of the sand] subsp. ***riddellii*** (Van Eseltine) R. M. Tryon [J. L. Riddell, 1807–1865]. SAND SPIKE-MOSS; RIDDELL'S SPIKE-MOSS. Figure 8. Persistent perennial. Sporulates May - September. Dry sandy areas, sandstone and granite outcrops; Cumberland Plateau, Ridge and Valley, Piedmont Plateau; rare; [Coastal Plain]. State Rank, S2. Wetland Indicator Status, UPL. The range of *S. arenicola* subsp. *arenicola* includes Florida and southern Georgia. Van Eseltine named this species in honor of John Leonard Riddell, inventor of the binocular microscope and author of *Catalogus Florae Ludovicianae* published in 1852.

3. ***Selaginella braunii*** † Baker [E. M. Braun, 1889–1971]. BRAUN'S SPIKE-MOSS; TREELET SPIKE-MOSS. Figure 9. Persistent perennial; native to China. Sporulates May - September. Moist forested and open areas (escapes from ornamental plantings); Cumberland Plateau; very rare. Wetland Indicator Status, NI. This species is an escape from cultivation and is doubtfully well-established in our range. Named in honor of Emma Lucy Braun, an American ecologist.

4. ***Selaginella rupestris*** ★ (Linnaeus) Spring [of rocks]. ROCK SPIKE-MOSS; DWARF SPIKE-MOSS. Figure 10. Persistent perennial. Sporulates May - September. Flat sandstone and granite outcrops, sandy areas; Cumberland Plateau, Ridge and Valley, Piedmont Plateau; rare. State Rank, S2S3. Wetland Indicator Status, UPL.

Class 2. LYCOPODIOPSIDA

Order 1. LYCOPODIALES

1. LYCOPODIACEAE (Clubmoss Family)

Selected reference: Wagner, W. H. and J.M. Beitel. 1993. Lycopodiaceae. In: Flora of North America Editorial Committee, eds, 1993+. Flora of North America. 3+ vols. New York and Oxford. Vol. 2, pp. 18–37.

1. Strobili occurring along the length of the stem; sporophylls (fertile leaves) similar to sterile leaves . . . . . *Huperzia*
1. Strobili occurring terminally along upper one-third of stem; sporophylls distinctly different from sterile leaves.
   2. Main erect stem unbranched; plants pale green, usually dying back during winter; plants primarily of wetland communities . . . . . *Lycopodiella*
   2. Main erect stem branching into several finger- or fan-like branchlets; plants shiny green, evergreen; plants primarily of upland communities.
      3. Strobili sessile; leafy branches usually 5 to 8 mm wide . . . . *Lycopodium*

3. Strobili with distinct peduncles; leafy branches usually 3 mm or less wide.. . . . . *Diphasiastrum*

1. DIPHASIASTRUM {dye-phase-ee-ASS-strum} Holub 1975 • Ground-cedars; Ground-pines • [Incomplete likeness to the genus *Diphasium.*]

Selected references: Holub, J. 1975. *Diphasiastrum*, a new genus in Lycopodiaceae. Preslia 14: 97–100. Wagner, W. H. and J.M. Beitel. 1993. *Diphasiastrum*. In: Flora of North America Editorial Committee, eds, 1993+. Flora of North America. 3+ vols. New York and Oxford. Vol. 2, 28–32.

1. Rhizomes close to ground surface (usually within 1 cm of surface or within leaf litter); underside 2 rows of sterile leaves shorter than 2 upperside rows; sterile leaves green . . . . . *D. digitatum*
1. Rhizomes well below ground surface (usually 1–6 cm below surface); underside 2 rows of sterile leaves similar in size to 2 upperside rows; sterile leaves bluish (glaucous) . . . . . *D. tristachyum*

1. *Diphasiastrum digitatum* ★ (Dillenius *ex* A. Braun) Holub [finger-like]. RUNNING GROUND-PINE; SOUTHERN RUNNING-PINE; CROWFOOT CLUB-MOSS. Figure 11. Evergreen perennial. Sporulates April - August. Mixed upland woods, roadsides, powerline rights-of-way, and other open areas; all highland provinces; occasional. Species of Special Concern (Freeman *et al.* 1979). Wetland Indicator Status, FACU. The specific epithet of this species refers to the finger-like appearance of the branchlets. Used as a decoration in wreaths. Often confused with the similar Northern Running-pine, *Diphasiastrum complanatum* (Linnaeus) Holub. Synonyms: *Lycopodium flabelliforme* (Fernald) Blanchard—S, R; *Lycopodium digitatum* Dillenius *ex* A. Braun—L.

2. *Diphasiastrum tristachyum* ★ (Pursh) Holub [three-spiked]. GROUND-CEDAR; SLENDER GROUND-PINE; DEEP-ROOT CLUB-MOSS. Figure 12. Evergreen perennial. Sporulates April - August. Mixed upland woods, roadsides, powerline rights-of-way, and other open areas; Cumberland Plateau; very rare. State Rank, SR. Wetland Indicator Status, UPL. The state rank was based on an old record by E. W. Graves who collected it in 1917 on top of Sand Mountain near Higdon in Jackson County. It has recently been collected from Jackson County. *Diphasiatrum digitatum* and *D. tristachyum* are known to interbreed to form the infertile hybrid *Diphasiastrum* X *habereri* (House) Holub. Synonym: *Lycopodium tristachyum* Pursh—S, R, L.

2. HUPERZIA {hew-PURR-zee-uh} Bernhardi 1801 • Fir-mosses; Hanging Club-mosses • [For Johann Peter Huperz, a German fern horticulturist.]

Selected references: Wagner, W. H. and J.M. Beitel. 1993. *Huperzia*. In: Flora of North America Editorial Committee, eds, 1993+. Flora of North America. 3+ vols. New York

and Oxford. Vol. 2, pp. 20–24. Waterway, M. J. 1986. A reevaluation of *Lycopodium porophilum* and its relationship to *L. lucidulum* (Lycopodiaceae). Sys. Bot. 11: 263-276.

1. Sterile leaves widest above middle, leaves of varying lengths resulting in a tufted (shaggy) appearance, leaves with toothed upper margins; main stem frequently branching so that plant often forms dense clumps; plant mainly of soil in rich rocky woods. . .*H. lucidula*
1. Sterile leaves widest below middle, leaves of essentially same length, leaves typically with entire margins (sometimes toothed); main stem usually branching only 2 to 3 times; plant growing directly on acidic rocks . . . . . *H. porophila*

1. ***Huperzia lucidula*** ★ (Michaux) Trevisan [somewhat shining]. SHINING CLUB-MOSS; SHINING FIR-MOSS. Figure 13. Evergreen perennial. Sporulates June - September. Rich rocky woods, plant mainly grows directly from soil; Cumberland Plateau; rare. State Rank, S2. Wetland Indicator Status, FACW. The common names are derived from the shiny appearance of the leaves. This species and *Huperzia porophila* form a sterile hybrid known as *Huperzia* X *bartleyi* (Cusick) Kartesz & Gandhi. Synonym: *Lycopodium lucidulum* Michaux— S, R, L.

2. ***Huperzia porophila*** ★ (F. Lloyd & L. Underwood) Holub [lover of stone]. ROCK CLUB-MOSS; CLIFF CLUB-MOSS. Figure 14. Evergreen perennial. Sporulates June - September. Rich rocky acidic woods, plant usually grows directly on rock outcroppings; Cumberland Plateau; rare. State Rank, S1. Wetland Indicator Status, UPL. This species is known to occur in Winston County, Alabama. Synonyms: *Lycopodium porophilum* F. Lloyd & L. Underwood— M, S, R, L.

3. LYCOPODIELLA {lye-koh-POH-dee-ell-uh} Holub 1964 • Bog Club-mosses • [A diminutive form of *Lycopodium.*]

SELECTED REFERENCE: Wagner, W. H. and J.M. Beitel. 1993. *Lycopodiella*. In: Flora of North America Editorial Committee, eds, 1993+. Flora of North America. 3+ vols. New York and Oxford. Vol. 2, pp. 34–37.

1. Horizontal stems creeping flat on ground (rooting throughout on ventral surface), leaves entire to slightly toothed; strobili (cones) only slightly wider than adjacent stem (1–2 mm wider); leaves of upright stem and sporophylls appressed . . . . . *L. appressa.*
1. Horizontal stems arching (only rooting where touching ground), leaves strongly toothed; strobili distinctly wider than adjacent stem (3–6 mm wider); leaves of upright stem and sporophylls spreading to ascending . . . . . *L. alopecuroides.*

Note: *Lycopodiella prostrata* (Harper) Cranfill [*Lycopodium prostratum* Harper], Feather-stem Club-moss, Prostrate Club-moss, occurs in Coastal Plain portions of counties adjacent to our study area. It is very similar to *L. appressa*, the horizontal stems creep flat on the ground, but the leaves are strongly toothed and the leaves of upright stem and sporophylls are not appressed.

1. ***Lycopodiella alopecuroides*** (Linnaeus) Cranfill [resembling *Alopecurus*, foxtail grass]. FOXTAIL CLUB-MOSS; FOXTAIL BOG CLUB-MOSS. Figure 15. Deciduous perennial. Sporulates July - September. Wet areas including ditches, emergent wetlands, pond margins, and forested wetlands; Ridge and Valley; rare; [chiefly Coastal Plain]. Wetland Indicator Status, OBL. This species is believed to be one of the first American members of this group examined by Linnaeus (Thieret 1980). Synonym: *Lycopodium alopecuroides* Linnaeus—M, S, R, L.

2. ***Lycopodiella appressa*** (Chapman) Cranfill [appressed]. SOUTHERN CLUB-MOSS; APPRESSED BOG CLUB-MOSS; TIGHT-LEAF CLUB-MOSS. Figure 16. Deciduous perennial. Sporulates July - September. Wet areas including ditches, emergent wetlands, pond margins, and forested wetlands; Cumberland Plateau; rare; [chiefly Coastal Plain]. Wetland Indicator Status, OBL. The specific epithet refers to the appressed sporophylls. This species is known to hybridize with *Lycopodiella alopecuroides* and other members of this genus. No effort is made to separate the hybrids within this treatment. Synonyms: *Lycopodium adpressum* (Chapman) Lloyd & Underwood—M; *Lycopodium appressum* (Chapman) F. Lloyd & L. Underwood—S, R, L.

4. LYCOPODIUM {lye-koh-POH-dee-um} Linnaeus 1753 • Club-mosses • [Greek *lykos*, wolf, and *pous*, *podes*, foot; in reference to the resemblance of a wolf's paw].

Selected reference: Wagner, W. H. and J.M. Beitel. 1993. *Lycopodium*. In: Flora of North America Editorial Committee, eds, 1993+. Flora of North America. 3+ vols. New York and Oxford. Vol. 2, pp. 25–28.

1. ***Lycopodium obscurum*** ★ Linnaeus [obscure]. PRINCESS-PINE; TREE CLUB-MOSS. Figure 17. Evergreen perennial. Sporulates August - February. Rich wooded slopes and floodplains; Cumberland Plateau; rare. State Rank, S1. Wetland Indicator Status, FACU-. The specific epithet *obscurum* refers to the deep, "hidden" rhizome (Snyder and Bruce 1986). Foliage from this species has been used as a decoration during the Christmas season (Dean 1969), but should not be collected due to its rarity. The common name is derived from its tree-like resemblance.

REFERENCES CITED

Abbe E. 1981. The Fern Herbal. Comstock Publishing Associates. Ithaca and London.

Alabama Natural Heritage Program [ANHP]. 1994. Vascular Plant Inventory Tracking List, April edition. Montgomery, Alabama.

Alabama Natural Heritage Program. 1996. Species Inventory List. Montgomery, Alabama.

Alabama Natural Heritage Program. 1997. Inventory List of Rare, Threatened, and Endangered Plants, Animals, and Natural Communities of Alabama. Montgomery, Alabama.

Alabama Natural Heritage Program. 1999. Inventory List of Rare, Threatened, and

Endangered Plants, Animals, and Natural Communities of Alabama. Montgomery, Alabama.

Brunton, D. F. and D. M. Britton. 1997. Appalachian quillwort (*Isoëtes appalachiana*, sp. nov. ; Isoëtaceae), a new pteridophyte from the eastern United States. Rhodora 99: 188-133.

Dean, B. E. 1969. Ferns of Alabama. Southern University Press, Birmingham.

Freeman, J. D., A. S. Causey, J. W. Short, and R. R. Haynes. 1979. Endangered, threatened, and special concern plants of Alabama. Department of Microbiology, Agricultural Experiment Statioin. Departmental Series no. 3, Auburn University.

Lellinger, D. B. 1985. A Field Manual of the Ferns and Fern-allies of the United States and Canada. Washington, D. C.

Mohr, C. 1901. Plant Life of Alabama. Cont. U. S. Nat. Herb. 6.

Pohl, R. W. 1955. Toxicity of ferns and *Equisetum*. Amer. Fern J. 45: 95-97.

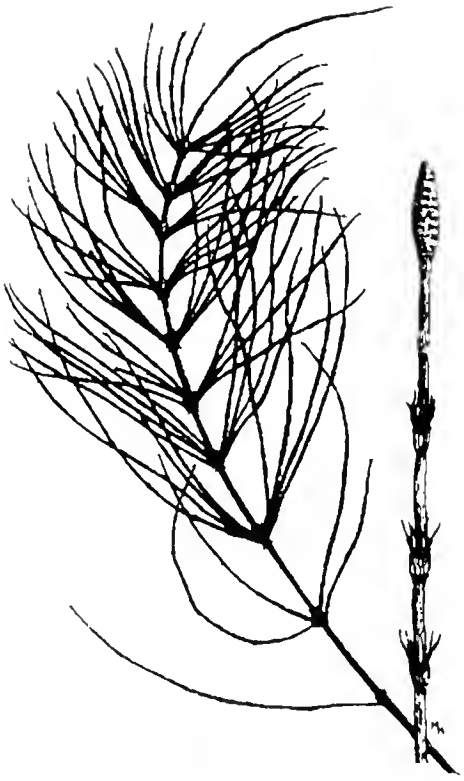
Radford, A. E., H. E. Ahles, and C. R. Bell. 1968. Manual of the Vascular Flora of the Carolinas. The University of North Carolina Press.

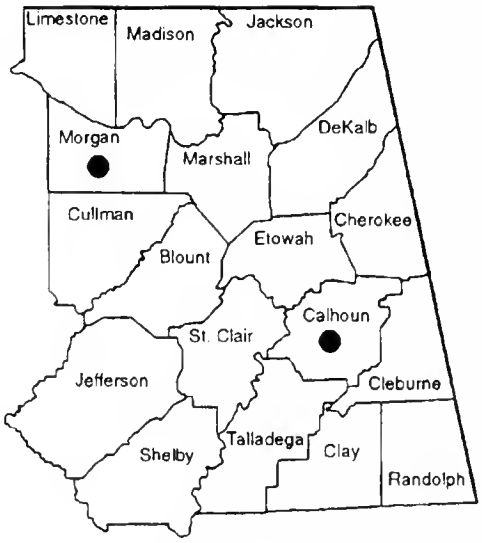
Reed, P.B. 1988. National List of Plant Species that Occur in Wetlands: Southeast (Region 2). U.S. Fish and Wildlife Service, Biological Rep. 88 (24), 244 p.

Small, J. K. 1938. Ferns of Southeastern States. Published by author. New York.

Snyder, L. H. and J. G. Bruce. 1986. Field Guide to the Ferns and Other Pteridophytes of Georgia. The University of Georgia Press.

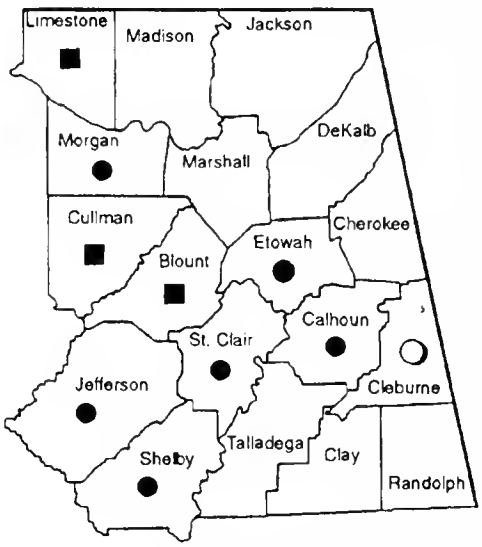
Theiret, J. W. 1980. Louisiana Ferns and Fern Allies. Lafayette Natural History Museum in conjunction with the University of Southwest Louisiana. Lafayette, Louisiana.





Equisetum arvense

Figure 1. *Equisetum arvense*- Field Horsetail



Equisetum hyemale

Figure 2. *Equisetum hyemale*- Common Scouring-rush

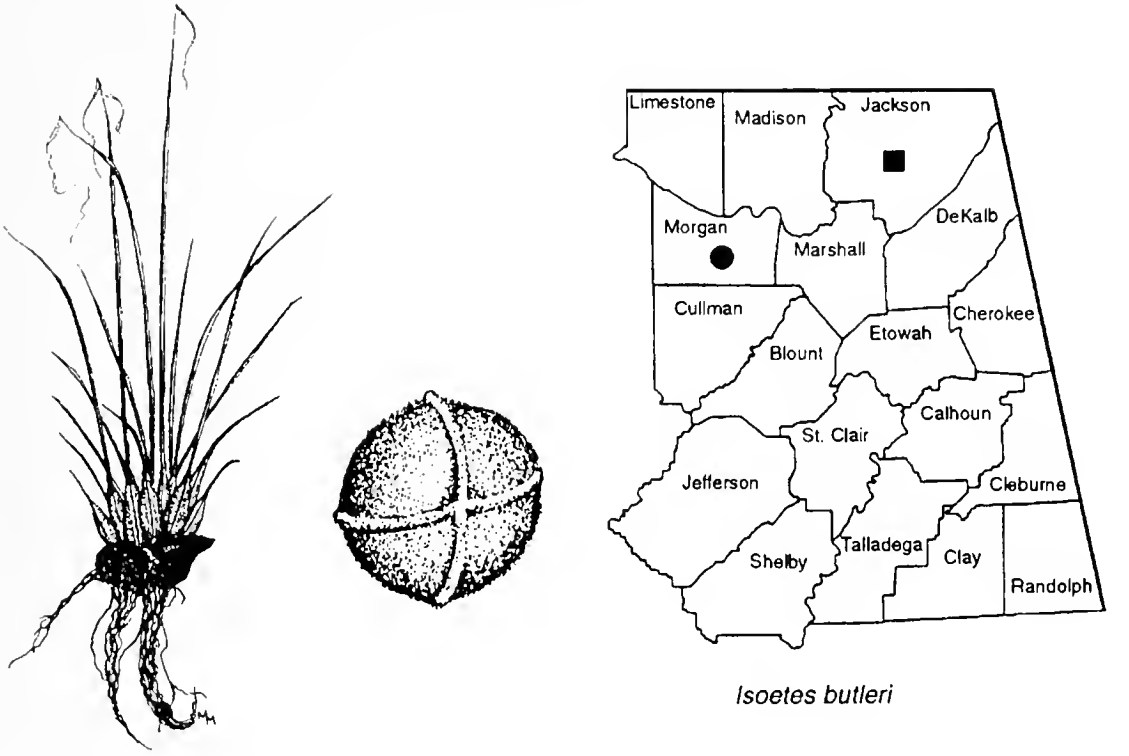


Figure 3. *Isoetes butleri-* Butler's Quillwort

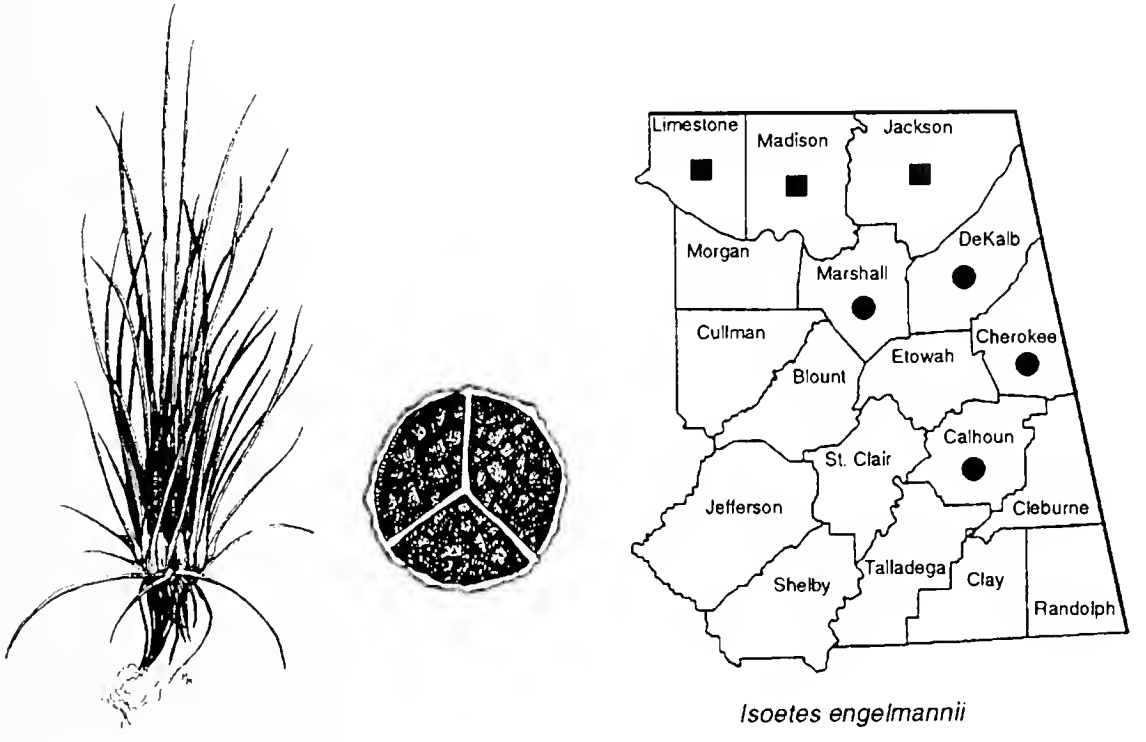


Figure 4. *Isoetes engelmannii-* Engelmann's Quillwort

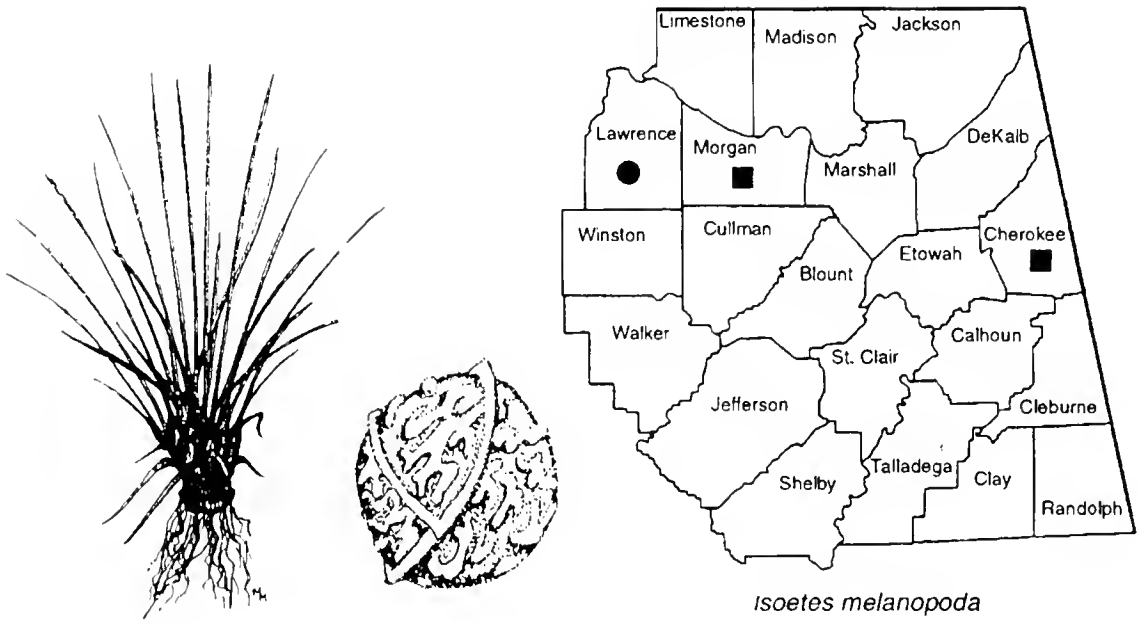


Figure 5. *Isoetes melanopoda*- Black-footed Quillwort

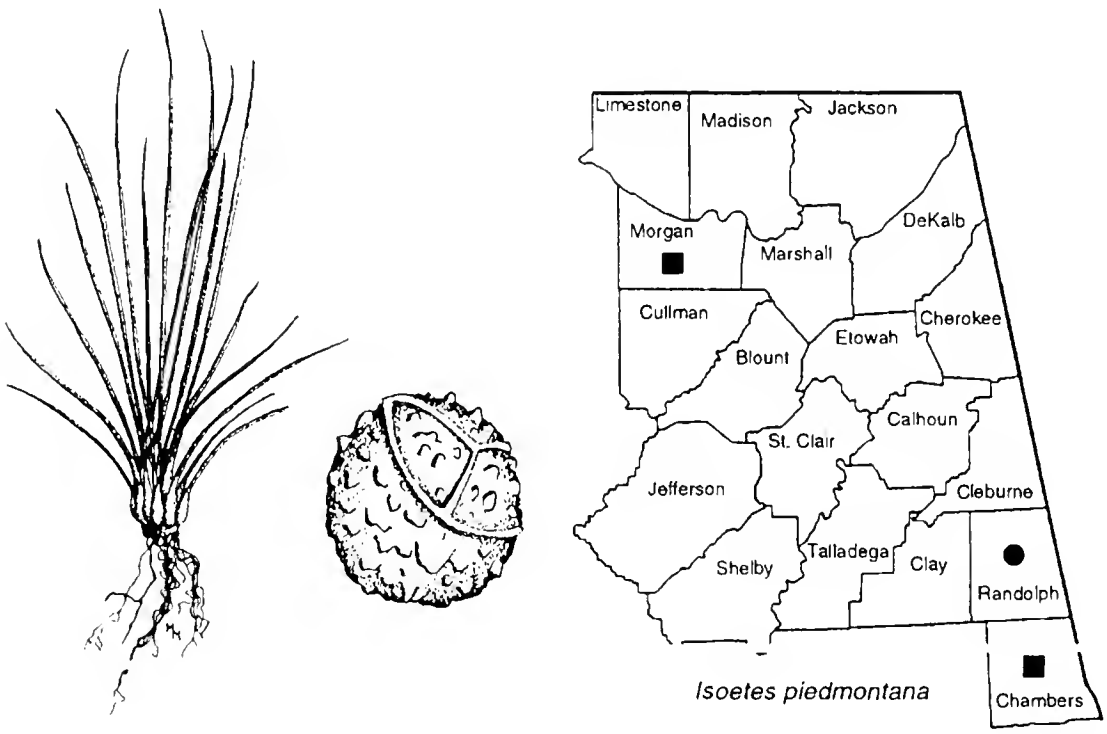


Figure 6. *Isoetes piedmontana*- Piedmont Quillwort

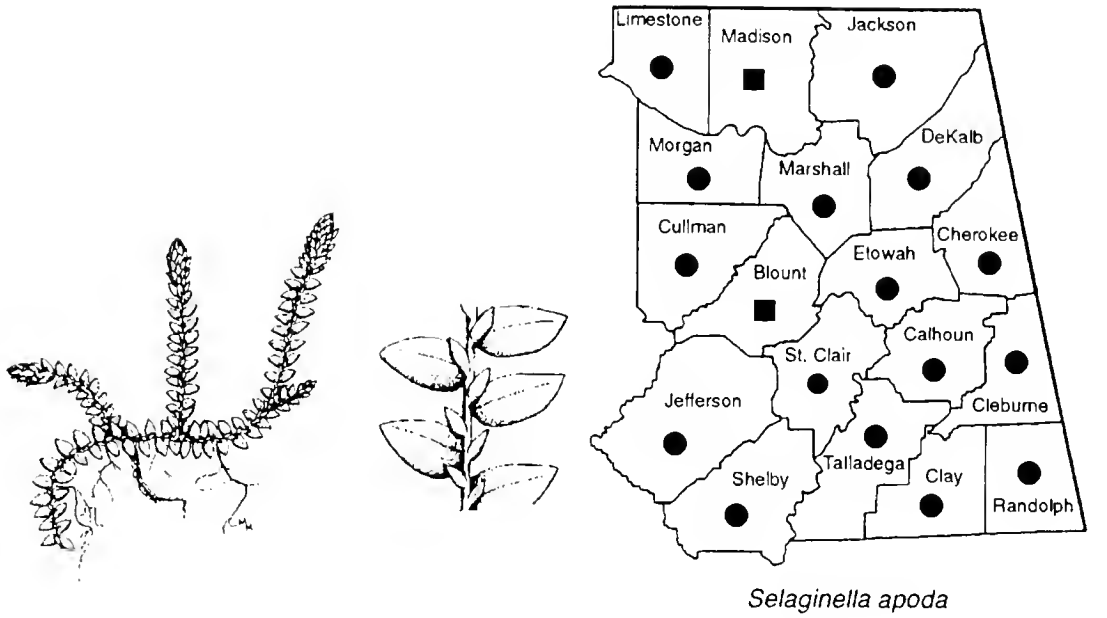


Figure 7. *Selaginella apoda*- Meadow Spike-moss

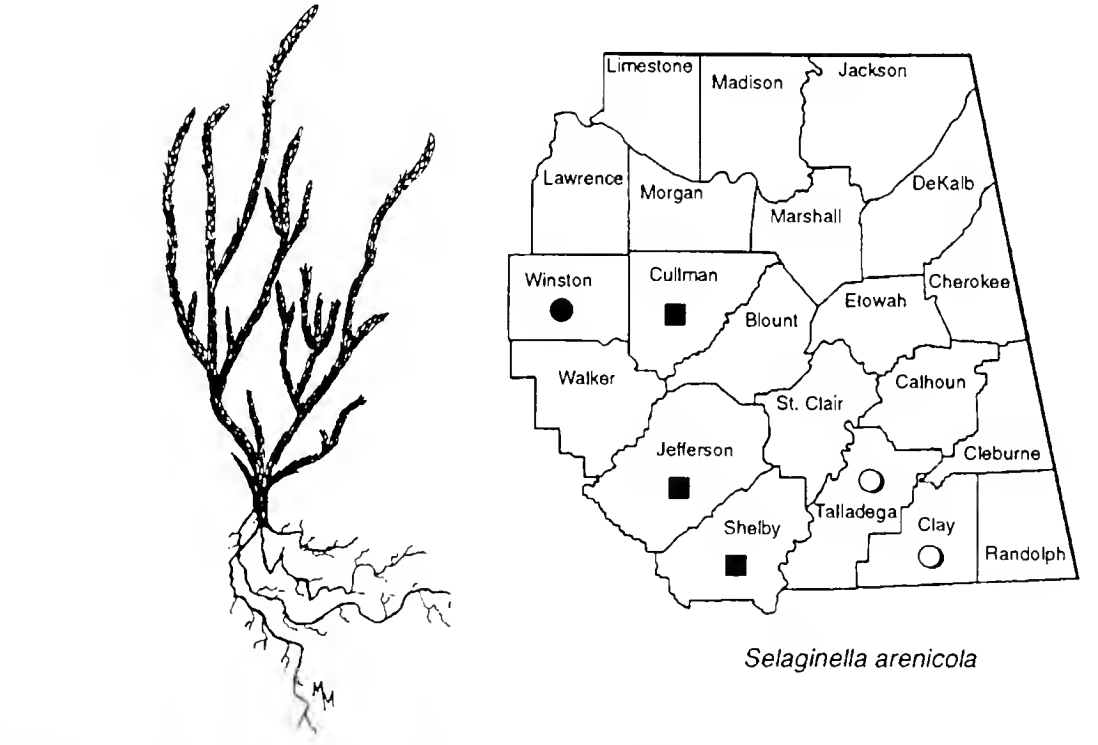
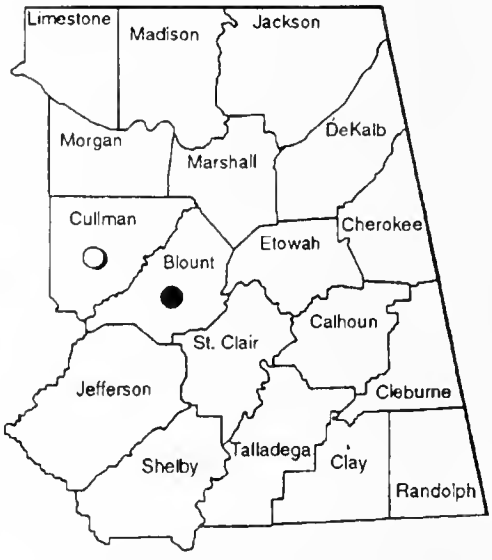
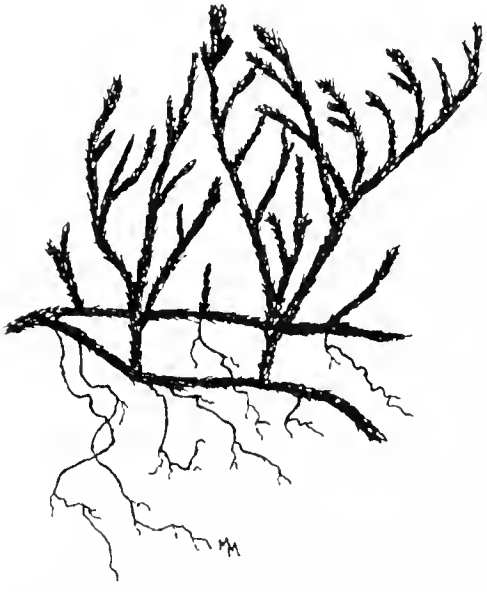


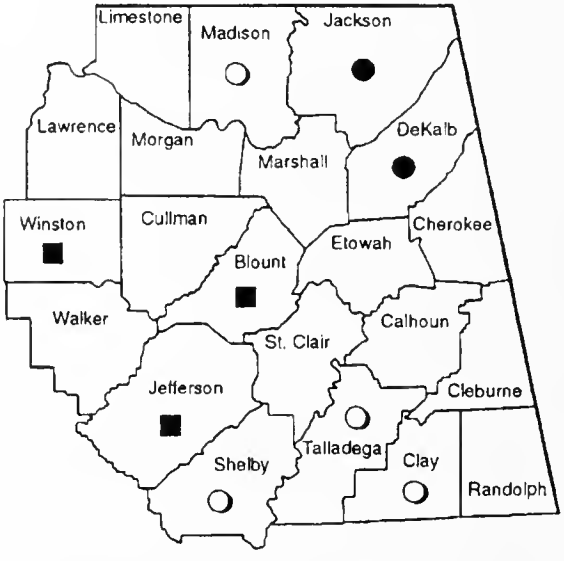
Figure 8. *Selaginella arenicola*- Sand Spike-moss



Selaginella braunii

Figure 9. *Selaginella braunii*- Braun's Spike-moss





Selaginella rupestris

Figure 10. *Selaginella rupestris*- Rock Spike-moss

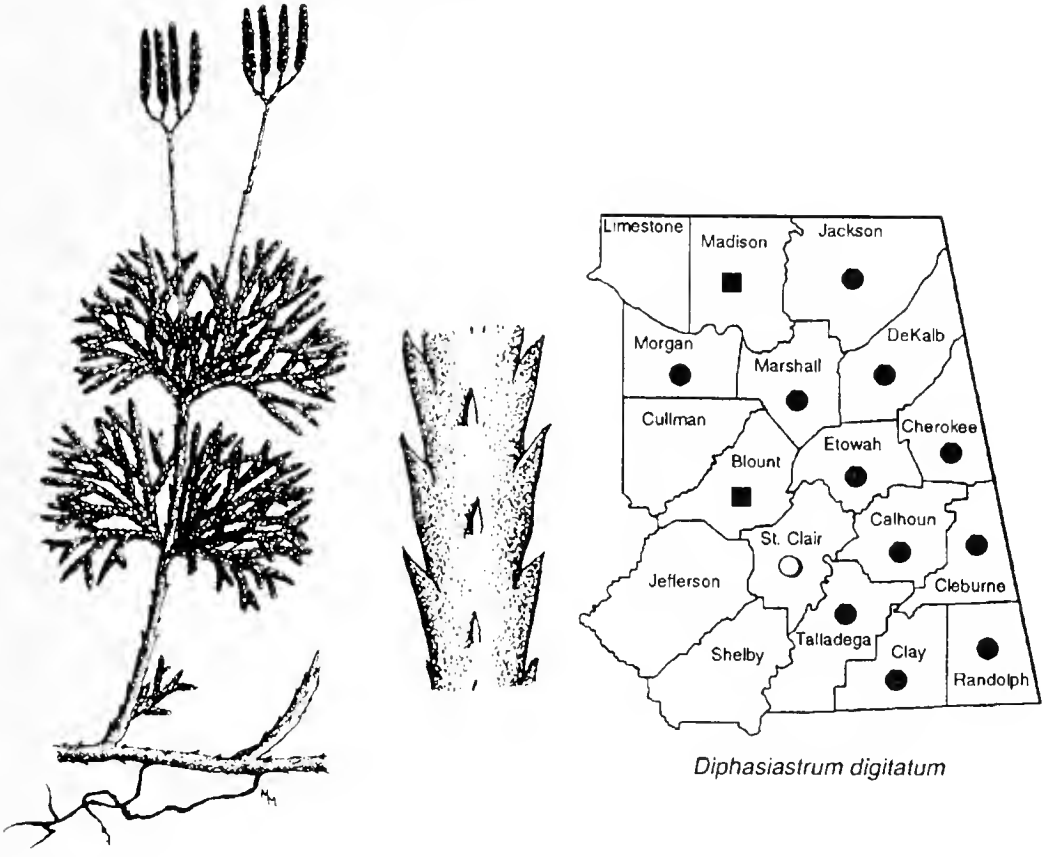


Figure 11. *Diphasiastrum digitatum*- Running Ground-pine

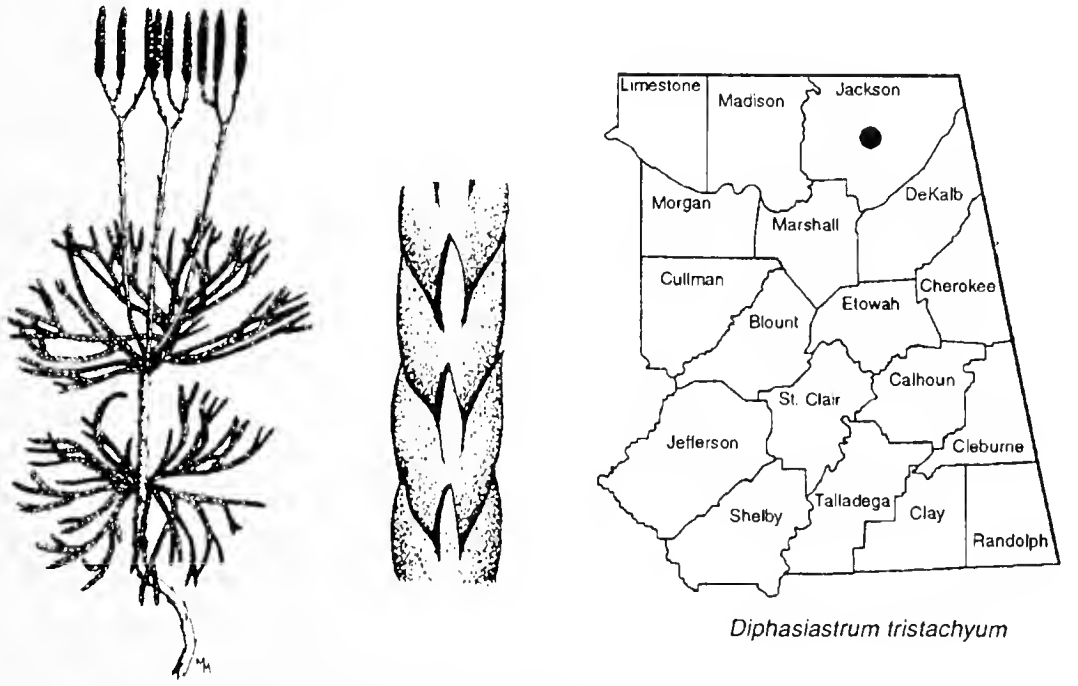


Figure 12. *Diphasiastrum tristachyum*- Ground-Cedar

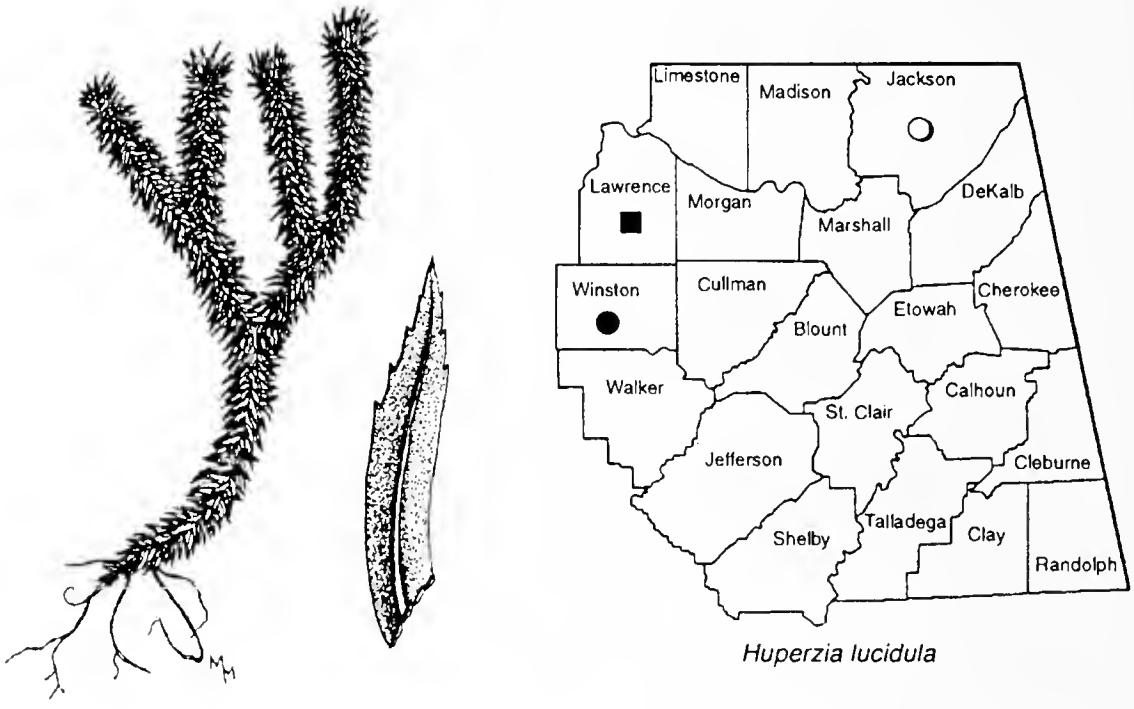


Figure 13. *Huperzia lucidula*- Shining Club-moss

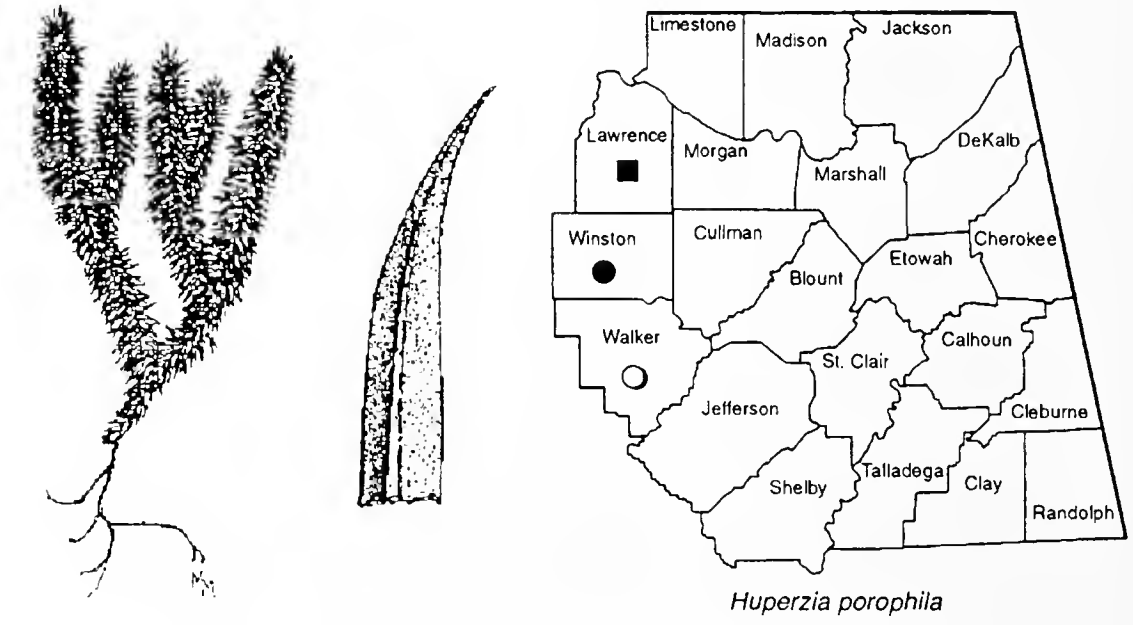
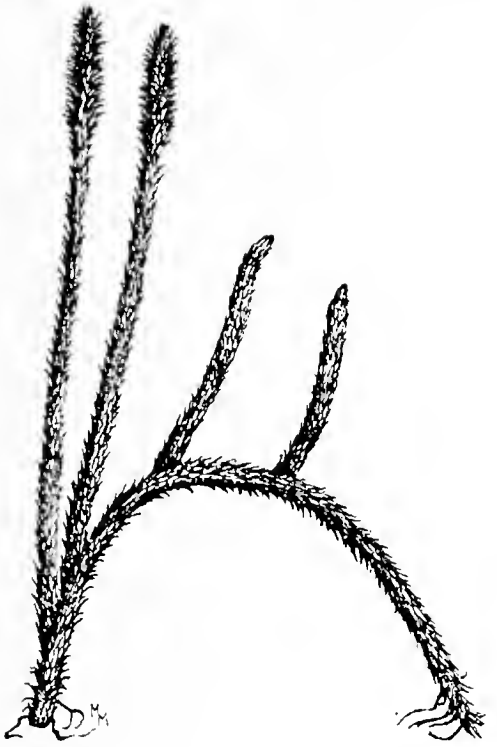


Figure 14. *Huperzia porophila*- Rock Club-moss



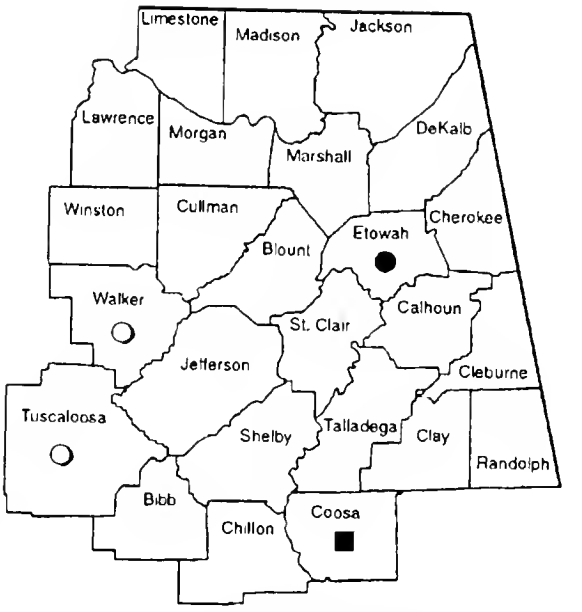
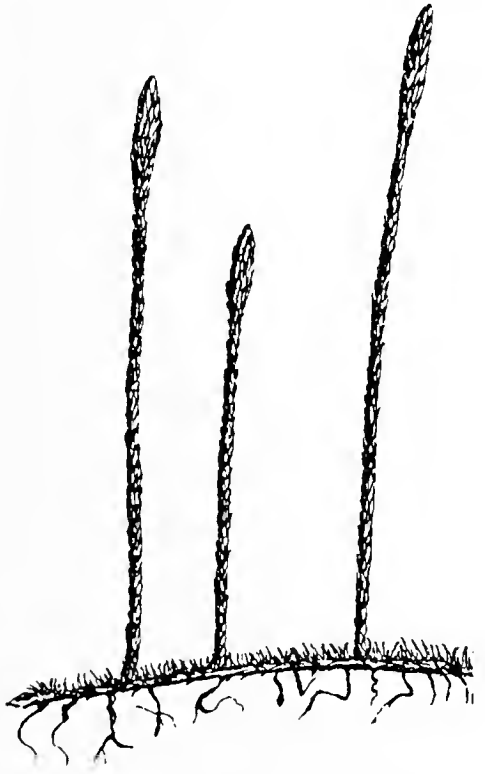


Figure 15. *Lycopodiella alopecuroides*- Foxtail Club-moss



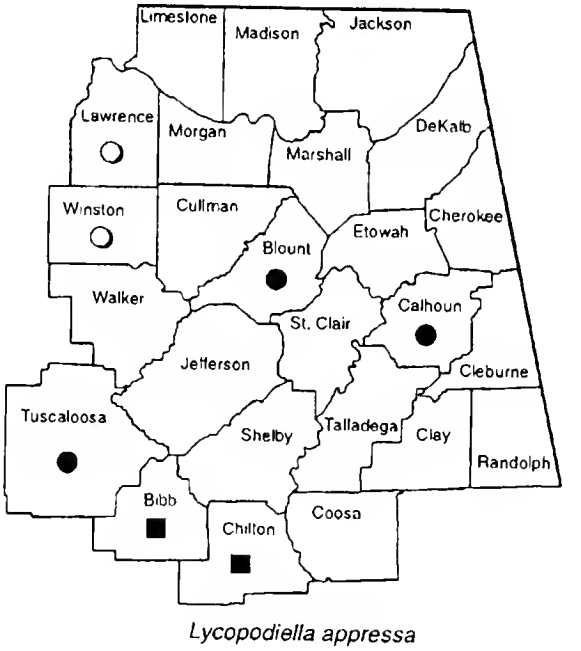
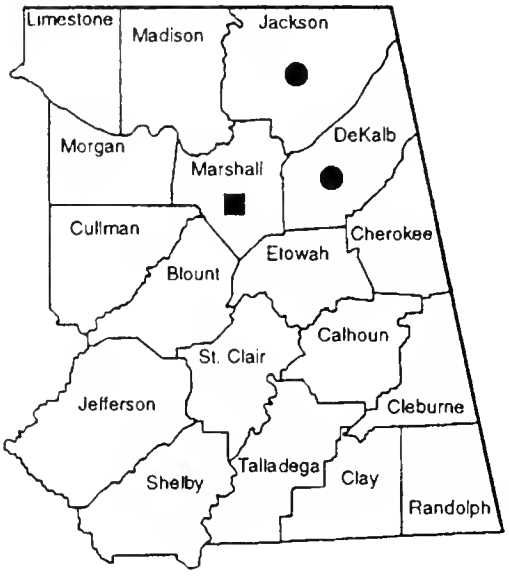


Figure 16. *Lycopodiella appressa*- Southern Club-moss



Lycopodium obscurum

Figure 17. *Lycopdium obscurum*- Princess-pine

Journal of the Alabama Academy of Science, Vol. 71, No. 4, October 2000.

FEMINIZATION OF POVERTY IN THE LABOR FORCE: 1980-1998*

Janice E. Clifford Wittekind
Auburn University
Department of Sociology,
Anthropology and Social Work
7030 Haley Center
Auburn, AL 36849

Arthur S. Wilke
Auburn University
Department of Sociology,
Anthropology and Social Work
7030 Haley Center
Auburn, AL 36849

ABSTRACT

Gender differences in income and labor force participation are well documented. Among the factors cited that suppress faster reduction in income inequality are disadvantages experienced by women with respect to changes in marital status and household composition. Taken together, these are used to support the "feminization of poverty" thesis. It is this thesis that is revisited in the paper. This paper examines labor force participation of full-time and part-time workers of two age cohorts, 20-39 and 40-59, examining the distribution and (constant dollar) income of age-sex cohorts during these two years. Data are based on the Labor Extracts prepared by the National Bureau of Economic Research (NBER) from the Current Population Survey. Though labor force conditions support the "feminization of poverty" thesis, there is also a companion trend noted, one that may be termed the "masculinization of poverty." The declining proportions of males in full-time positions, the growth in part-time labor by both males and females and the growth in the proportion of males in a "deprived" income subcategory are among those trends observed.

* A prior version of this paper was presented at the 2000 Alabama Academy of Science Meeting in Birmingham, AL

INTRODUCTION

There is much talk about how the U.S. labor market has expanded and provided more opportunities for those seeking employment. In a time where there are expanding opportunities in the labor force and a shortage of workers exist, why then do we see more person living in poverty? For the answer we must look to the structural transformations that have taken place in the economy over the last 20 years. In order to assess the current situation for those workers, we must look at several factors including growth in sectors of the labor market, types of jobs available, and the wage structure.

While changes have occurred in occupations and opportunities, disparities such as poverty, persist, if not grew. One of the ways this has been expressed is by the feminization of poverty thesis that we shall describe. We use this thesis to orient our efforts to probe changing labor force conditions.

The feminization of poverty thesis asserts that women are disadvantaged vis-a-vis men. The thesis rests on two elements: changes in household composition, especially family households headed by women, and women receiving lower pay than men. In this paper we first examine if the macro trends, especially those relying on household-level data are supportive of the feminization of poverty thesis. We then turn to examining how labor force conditions and participation are either amplifying or challenging the feminization of poverty thesis. The latter approach is done since labor force involvement is a critical precondition for whatever life chances people will have in their various household arrangements.

This research examines changes over time in labor force participation and wages for women. Of particular interest is the labor market impact on families' economic stability. What makes this research different from previous studies is that it 1) traces the distribution and income of the labor force over time, 2) examines changes in cohorts over time, and 3) focuses on persons in marginal income categories.

LITERATURE REVIEW

Gender, Work and Poverty

When explaining women's position in the economic structure, we look to their position in the labor market. The structure of the labor market places them in a disadvantaged position economically, increasing their risk of poverty. Our discussion leads us to examine the perspectives set forth to account first for women's position in the labor market and second in turn how their position affects their economic stability. Popular explanations focus on comparable worth, sex-segregated occupational opportunities, and human capital model to understand women's mistreatment in the labor force.

Women on average have lower earnings compared to men. One explanation for the pay gap between men and women has used the notion of comparable worth. Comparable worth centers on comparison of pay for different jobs that require some distinct tasks (England 1999). When comparing jobs that are primarily female dominated to male dominated we tend to find that lack of comparable worth assists in explaining pay differentials. As women have increased their labor force participation, the issue of comparable worth becomes even more salient.

When examining women's place in the labor force, we see them heavily concentrated in female dominated jobs that pay less then male dominated jobs. These positions are mainly located in the personal and service sectors of the market, and as a result on average pay less and have fewer benefits (England 2000; Haynie and Gorman 1999). Data from 1996 reveals that the median earnings of U.S. women who worked full-time year round was 73.8% of men's median earnings (Institute for Women's Policy Research 1998). Acknowledging that many women have a reduction in their labor force participation to tend to childrearing as a result they average less experience and seniority and more often work part-time. After controlling for these factors, such estimates account for only 40% of the of the sex pay gap (Wellington 1994). A large proportion of the residual difference is women's concentration in lower-paying jobs (England 2000).

Wage inequality is reinforced by occupational gender segregation. Working in "female" jobs (where females are the majority of employees) provides those workers with low paying employment (Haynie and Gorman 1999). Sex-segregated employment opportunities (such as service employment) tend to have lower wages (Lord 1993), though equality emerges in minimum wage jobs. In service industries where the largest proportions of new jobs emerge for women, pay is lower. In such occupations, women's pay is half of the median income of persons employed in professional and manufacturing occupations (Zopf 1989). Growth in the service sector of the labor market has been directly correlated with increase in women's poverty (Kodras and Jones 1991; Tomaskovic-Devey 1987).

Employers play a role in maintaining sex-segregated occupations and the wage gap through discriminatory hiring practices. Employer's reluctance to hire women for "male" jobs creates an oversupply of women. Women denied access to "male" jobs, places them in competition with each other for limited positions. This results in lowered wages, based on the tenets of supply and demand, as there is a larger supply of labor (relative to the demand) to fill "female" jobs (Bergmann 1971, 1986).

It is not enough to acknowledge that women earn less than their male counterparts, but understand why the wage differences are worthwhile discussing. In particular, women's wages have become increasingly important given the trends over the last several decades in age at first marriage, nonmarital births, and divorce. We see a trend in persons delaying marriage as indicated by their increased age at time of first marriage. This pattern holds true for both males and females during the period 1970-1990. In 1970, males and females were marrying at much younger ages, 22.5 and 20.6 respectively, in comparison to 1990, when median ages were 25.9 and 24.0 (U.S. Census Bureau 1999:111).

The time when lack of comparable worth really becomes most salient is when the family unit is headed by a single parent. From 1960-1990, we have seen an increase for women aged 25-29 who had never married from 11% to 32% and an increase for those aged 30-34 who had never been married from 7% to 18% (Spain and Bianchi 1996). The projected estimates for divorce are that about 50% of the cohort born in the 1950s (Cherlin 1981; Preston and McDonald 1979) and those marrying today (Martin and Bumpass 1989) are expected to get divorced. In some instances this leaves the sole breadwinner responsible for both herself and children. Here we see evidence in particular that women with children are affected the most by lower earnings.

An additional factor linked to women's earnings is the presence of children (Hill 1979; Jacobson and Levin 1995; Korenman and Neumark 1992; Waldfogel 1994, 1997). The notion of "family gap" exists when mothers earn lower hourly wages then women who do not have children (Fuchs 1988; Waldfogel 1994). This is explained by the fact that women with children have less labor market experience in comparison to their non-parent female counterparts (Hill 1979). Using the National Longitudinal Survey of Young Women, Waldfogel (1997) estimated the actual amount of time women have participated in the labor market since leaving high school. It was found that women who did not have children were employed 77% of the time, married mothers 66%, previously married mothers 64%, and never-married mothers 59%. For all women, the average time spent in the labor market was 69%. We can see that women with children, regardless of their marital status, have a lower participation rate in the paid labor force.

Women's risk for poverty is influenced by the available stock of human capital to participate in the labor market (Haynie and Gorman 1999). The human capital model (Becker 1985) posits that the wage gap between mothers and non-mothers is due, in part by the lessened participation of mothers in the labor market. Reduced time in the labor market, nets reduced work experience and as a result earnings are less. In addition, for some women childbearing earlier in the life cycle may reduce opportunities for human capital acquisition such as provided by education. It suggests that there are really two wage gaps women encounter, the first one with men and a second with women.

While our focus in not on providing evidence as to how children affect women's wages, but to consider how employers may often treat women unequally, depending on their family status. Further, women with children may have less human capital and flexibility with which to bargain in the labor market. This would make them more likely to reside in part-time employment because it of lessened accumulations of human capital. Typically these part-time position are low pay, without benefits, and possess little opportunity for raises (Blank 1990).

A related explanation for the differences may be accounted for by individual women's personality traits. Such characteristics like motivation or commitment to the job may be more critical than the presence of children in explaining the wage differentials (Waldfogel 1997). It is possible that women who have children are less committed to the labor market and less motivated to continue to work while raising children. This itself may explain the presence of mothers in part-time employment, where they can more easily balance family and work responsibilities. Full-time employment may not be an option, as it tends to be more inflexible and often less family oriented. Tying individual characteristics with labor market opportunities have been found to differentially affect individuals' risk for poverty (Haynie and Gorman 1999).

While many explanations have been set forth accounting for the economic instability women experience, they have primarily focused on wage differentials. We will now turn our attention to demographic characteristics such as family structure, household compositions and their relationship to earnings.

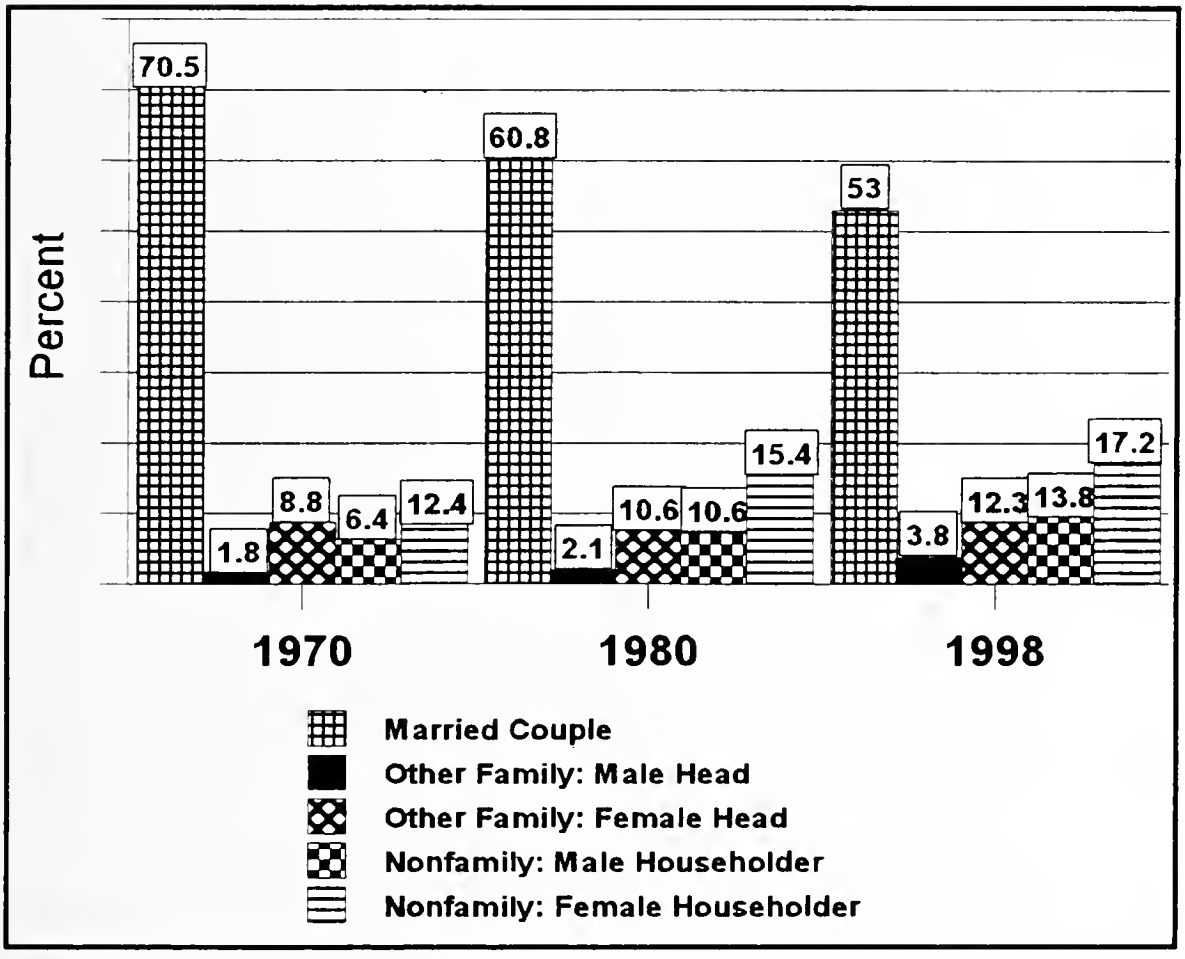
Household Formations, Conditions and Distributions

When discussing the factors leading to the feminization of poverty, most commonly emphasis has been placed on family structure. In particular, single-parent families have

often been the focus of research trying to explain the existence of poverty as they are at highest risk for economic instability. Examining factors leading to change in family structure, we see the decline in marriage rates from 10.6 per 1,000 in 1980 to 8.3 per 1,000 in 1998 provides preliminary support for the thesis. Although we see a decline in divorce rates from 5.2 per 1,000 in 1980 (U.S. Census Bureau 1998:114) to 4.3 per 1,000 in 1997 (U.S. Census Bureau 2000:104) suggesting a counter tendency, given the growing proportion of older persons population, these trends are likely overstated. A more precise measure focuses on family households. Such households declined from 81.4% of the total in 1970 to 73.7% in 1980 to 69.1% in 1997 (U.S. Census Bureau 1999:60).

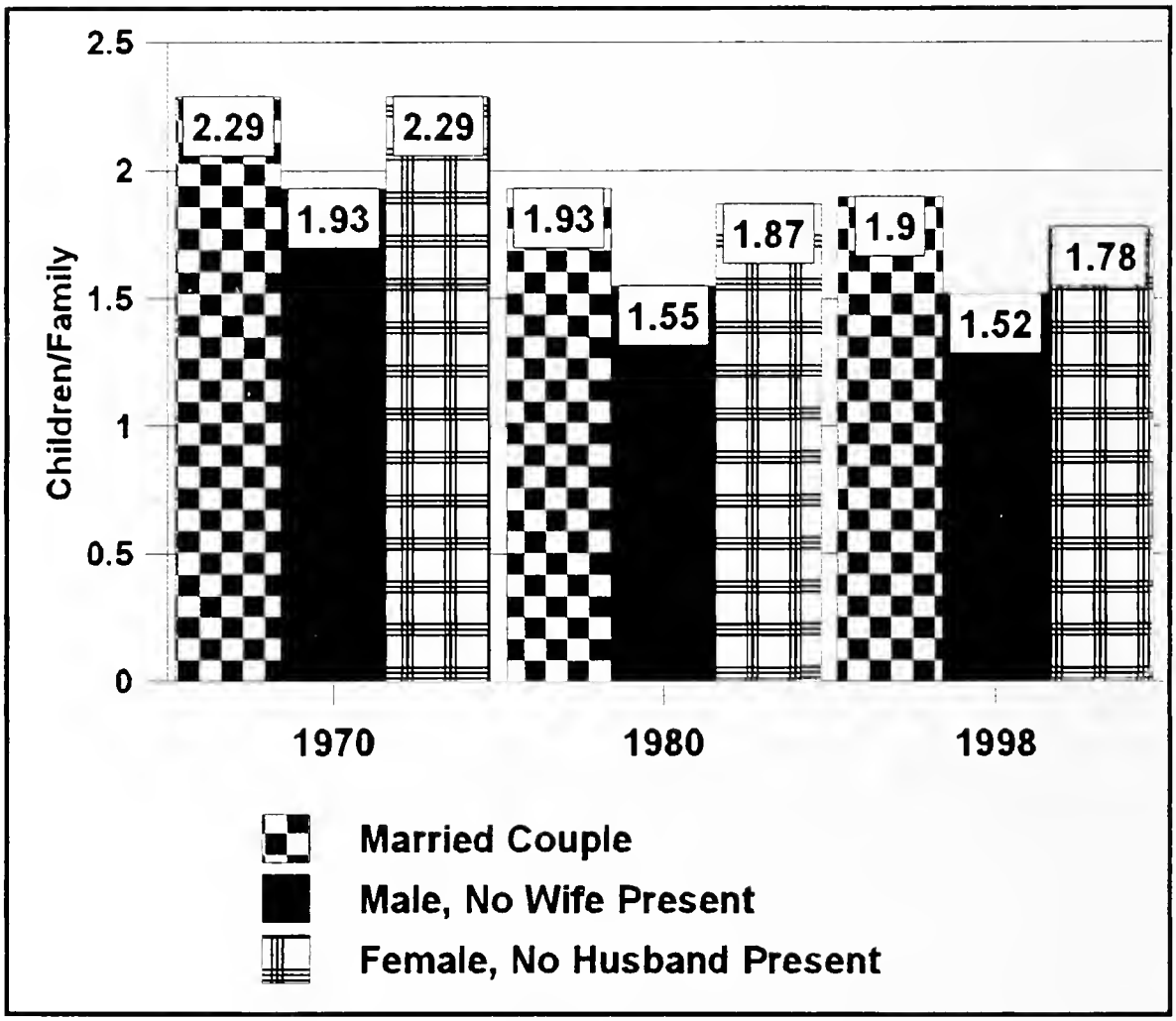
From 1970 to 1998, the number of households grew from 63.4 million to 102.5 million (U.S. Census Bureau 1999:60). Married couple households, however declined from 70.5% of the total in 1970 to 53.0% in 1998. All other household types increased. Female family households grew from 8.8% of the total in 1970 to 12.3% in 1998, with males growing more modestly, from 1.8% of the total in 1970 to 3.8% in 1998 (see Figure 1).

FIGURE 1. Household by Type: 1970-98



As might be expected, with more family households headed by single parents, mean household size is decreasing. In 1970 the family household averaged 3.58 persons. By 1998 this was down to 3.18 (U.S. Census Bureau 1999:60). In terms of the mean number of children under 18 per family, Figure 2 shows there has been a decline in all family types from 1970 to 1998. The largest decline is seen in female-headed households with children under 18: 2.29 to 1.78 per family (U.S. Census Bureau 1998a).

FIGURE 2. Number of Children Under Age 18 Per Family: 1970-98



Fewer children might somewhat buffer the extent of poverty in households. However, along with the 3.9 million increase in single-parent families with children under 18, 7.1 million in 1980 to 11.0 million in 1998 compared to only 0.6 million increase in married couple families with children under 18, from 25.6 million to 26.2 million in the same time period. In 1980 there were 1.9 million married couple families with children under 18 who were living in poverty. By 1998 this declined to 1.8 million. By contrast, male-headed households with children living in poverty increased from 144,000 to 350,000 while similar households headed by females increased about 800,000, from 2.7 million to 3.5 million (U.S. Census Bureau 1998b). Even though the rates of poverty among female-headed family households had declined modestly, from 32.7% of all such households to 29.9%, it has been dramatic growth in such households, 9.1 million in 1980 to 12.8 million in 1998, that has contributed to the growth in the absolute number of female-headed households with children living in poverty. Relative to dual-income married couples; unmarried women are becoming more economically disadvantaged. Unfortunately, mother-headed families are often hit the hardest, and fall below the poverty level in many cases (Duncan and Hoffman 1985; Weitzman 1985).

The shift away from married households to family households with no spouse present and to other household formations is marked. How such family households are doing is illustrated in Figure 3. This figure describes the proportion of households with low relative incomes.

The relative income measure

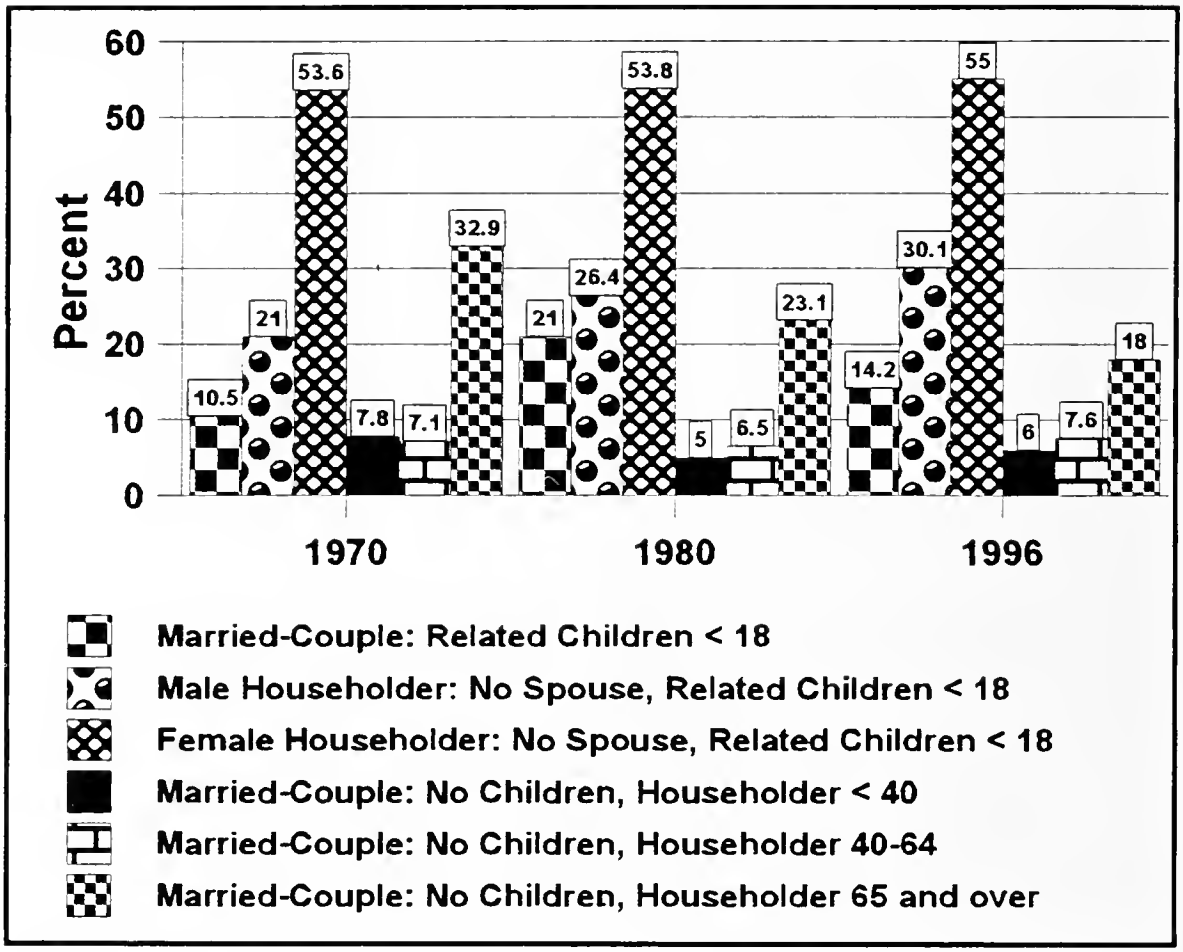
> uses an equivalence scale to adjust household income for the number of persons in the household and determines the relative income measure by comparing each household's adjusted income amount to the median adjusted income amount . . . . Households with relative income levels of less than 0.5 are considered to have low relative incomes . . . (McNeil 1998).

The trend is that proportionately more households with children under 18 have experienced declining economic fortunes as measured by the percent of those with low relative incomes. While this certainly impacts on female-headed households, it also seems to have an impact on other family household formations.

Figure 4 shows that of those family households with children under 18 married couples with wives' earnings included witnessed a median real (constant 1996 dollars) income growth between 1969 and 1996 of 25%, from $41,543 to $51,950. If wives' incomes are excluded, the increase is only a modest 1.5%. Males with no spouse present and with children under 18 saw a decline of -8.0% while their female counterparts experienced a 10.2% increase.

The portrait that emerges from the above is that females are increasingly heading households and while there are very modest improvements in their overall household income, the growth in their proportions among households is supportive of the feminization of poverty thesis. The question to which we turn is whether the conditions of labor force participation amplify the trends seen in households or are other factors at play?

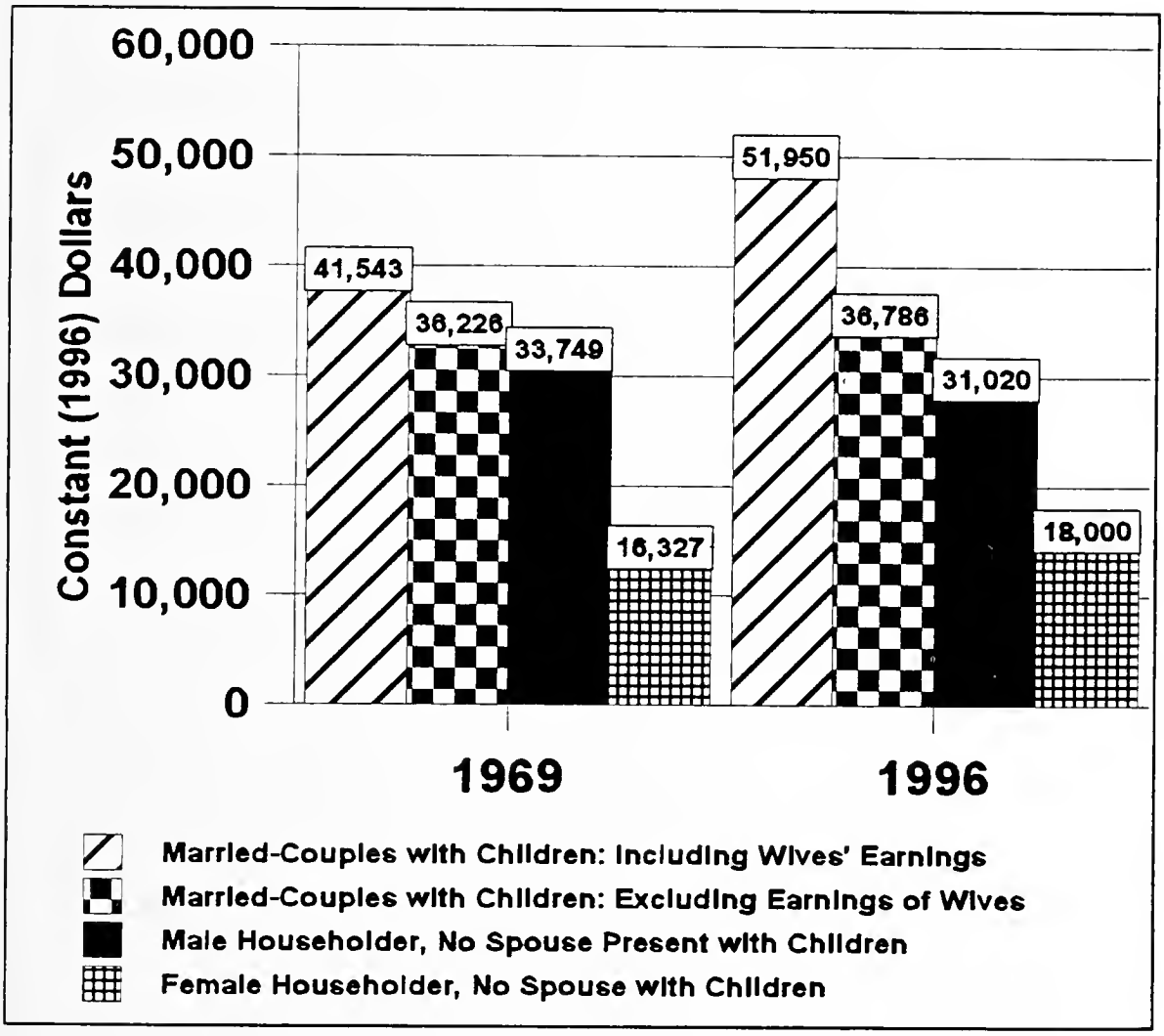
FIGURE 3. Percent Household with Low Relative Incomes by Type: 1970-96



Economic Stability: Labor Force Participation and Wages

Employment instability and economic deprivation are two components of economic distress that indicate changes in patterns of employment and income over time (Voydanoff 1984). Economic deprivation is associated with economic instability resulting from loss of income. It is argued that the existence of and increase in poverty rates are a function of the labor market. Even though, there has been a decline in the income gap between men and women, structural changes in the labor market over the past two decades have mediated the effect of those gains. Recognizing that among most couples men still earn more on average than women, there is a growing importance placed on a wife's financial contribution to the household.

FIGURE 4. Median Income of Families with Children: 1969-96



To explain the role of the labor market as a catalyst to the feminization of poverty, we look at the structure of the labor force over the past nineteen years. It is argued that these have affected the economic position of women by revolutionizing the financial contributions women make to families (Spain and Bianchi 1996).

DATA AND PROCEDURES

To undertake the exploration of labor force involvement, we examine data on full-time and part-time workers as reported in the Current Population Survey (CPS). The CPS consists of interviews with some 50,000 persons a month. Survey participants are interviewed for four consecutive months and interviewed after an eight-month recess for another four-month sequence of interviews. On the fourth month of each interview cycle, labor force data, including working conditions and weekly pay are gathered. Though these data do not contain the socio-demographic and household income data of the March CPS surveys, they provide a more direct avenue into what working conditions of the workers are. And while there may be workers in multiple worker households who have modest jobs, the data provides a more direct measure of economic opportunity than does household data.

The National Bureau of Economic Research (NBER) has compiled 20 years of labor extracts from the CPS. Though limited in terms of socio-demographic information, the data provide some time-series details that are missing in commonly summarized sources. In addition, the Census Bureau-Labor Department personnel conducting the CPS provide weights for the sample so that population estimates can be made. The recommended income weight was used, after adjusting for appropriate population characteristics.

In this study two years, 1980 and 1998, were used from the NBER Labor Extracts of the CPS. Though the compiled data begins in 1979, it seemed reasonable to begin the work with a year that corresponds to that of the decennial census. The latest year was chosen for obvious reasons.

The 1980 data set has over 380,000 cases of which a maximum of a 168,820 persons with an identified marital status were selected. The number of those who were working was less. The 1998 abstract has over 280,000 cases of which 179,221 were found valid for this study. Most analyses performed here with the exception of a location item, involved 139,850 cases. Incomplete information of the locale of the respondent reduced that item (central city, remaining SMSA, non SMSA to 118,319). Once the full-time labor status was noted, the sample size was further reduced.

The CPS Labor Extracts file contains information on current salary and wages as well as current working hours. It does not contain annual wage data. In order to make hourly and salaried workers comparable the recommendation to compute average hourly pay done all persons who were working as of the week prior to the interview in either a full-time (generally 35 or more hours a week in paid employment for full-time) or part-time and who received an income.

The primary focus was on marital status of the full-time or part-time workers: married with spouse present, married but either separated or spouse absent, widowed or divorced, and never married. Because of the focus on the feminization of poverty, respondent's sex identity was used. In addition location as noted (central city, etc.),

education (less than high school, high school and more than high school), race and region were used for descriptive purposes. A measure to approximate a deprivation wage was constructed. After the mean hourly income of full-time workers for 1998, $14.09 per hour, was calculated, the classification of a deprivation income, one that would place working people at risk of being deprived was calculated using 50% of that amount or approximately $7.05 per hour. This is likely to be somewhat higher than the median income amount because of the skewed character of income data. Any hourly income below $7.05 placed the person in that category. After the 1970 hourly income was standardized for 1998 constant dollars, the same procedure of assignment of the deprived subcategory was followed. The measure is conservative given that it was based on 1998 when there was greater income inequality, especially at the top end of the income distribution. If growth in the proportion of those having deprivation in wages and salaries occurs over time, this would very likely understate the trend.

The sample was further reduced to deal with those 20 to 59 years of age to account for people who were most likely to be in the labor force. This age range also enabled the construction of two age cohorts that could be compared over time: 20 to 39 year olds and 40 to 59 year olds.

If a person worked 40 hours a week, 52 weeks a year, the yearly income would be $14,610. This amount seemed reasonable given that the poverty threshold in 1998 for a family of three was $13,003. Given that there is intermittent work as people enter and leave the labor force, the deprivation measure seemed to provide a comparative vehicle to assess opportunities in the labor force. Of course it does not provide details on the respondent's household such whether there were other wage earners and what characterized other household members. Nevertheless, the marital status item provides a rough approximation and highlights different kinds of arrangements, at least for those whose spouses are absent or who have died or from whom they are divorced.

FINDINGS

In 1980 there were an estimated 72.3 million persons aged 20 to 59 in the labor force working either full-time or part-time. Excluded from this report were those without a military connection or who were unemployed. They make up a small proportion of the total labor force.

Part-Time Labor a Larger Portion of Labor Force.

Most of those reported here work at full-time jobs. In 1980 full-time workers made up about 86.5% of the total labor force. By 1998 those with full and part-time jobs grew 78.0% to an estimated 92.6 million. The proportion of full-time workers declined to 78.8%.

Location: Region

There was generally modest growth in female's full-time employment. Table 1 shows that the proportion of full-time jobs of 20 to 39 years olds held by females in 1980 and 1998 hovered around 40% in most regions of the country. Of notable exception, there was a significant decline in full-time positions for females in the Mid-Atlantic region.

In 1980 females in this region made up approximately 39% of the full-time workers. In 1998 these 20-39 year olds proportion decreased to 32.3%. Overall, except for a modest decline in the Pacific region, females did not substantially increase their proportions among those who were working. Females in the 40 to 59 year old age categories increased their proportions among full-time laborers in all regions of the nation between 1980 and 1998.

On average, women of all ages make up a smaller proportion of part-time workers. In all regions of the country and in both age cohorts (20-39, 40-59), females make up a decreasing proportion of part-time workers. One exception to this trend was for females 20-39 living in the East South Central Region; they experienced an extremely slight increase in part-time employment.

By 1998, 20 to 39 year olds held about the same proportion of full-time jobs held by males and females of that age subcategory, however females ages 40-59 showed an increase from the upper 30% range to over 40% of the subcategory.

Location: Urban and Non Urban

Human ecological shows that location does not differentiate trends in women's full-time and part-time job patterns. Females 20-39 year olds did not substantially increase their proportion of full-time workers among those 20 to 39 years of age in various urban and non urban settings. In comparison, females in the older cohort, 40 to 59 increased their proportions. Though females continue to make up the largest proportion of part-time workers, their proportions decreased between 1980 and 1998 in both age cohorts in all geographical areas.

Education

Labor force participation by women with more than a high school diploma shows a significant increase. Between 1980 and 1998, females 20 to 39 years old increased their proportion of full-time employees among those with more than a high school diploma. Of those with a high school diploma or less, females made up a smaller proportion of the full-time workers in 1998 than in 1980. For this same age cohort, regardless of education level these females experienced a decline in part-time employment, most notably with a 17.9% from 1980-1998 for those with a high school education.

In the older age cohort, 40 to 59 year olds, females increased their proportion of full-time job occupants in all three education subcategories, led by those with more than a high school diploma: 34.4% in 1980, 43.3% in 1998. The part-time employment scenario is just the opposite, with all levels decreasing by at least 15%.

Marital Status

There are two instances where females have increased their labor participation from 1980-1998. First, women in both cohorts with spouses present have increased their full-time labor force participation. Second, never married 20-39 year olds, women have increased their portion of part-time job holders. In other relationships, women's proportion in full-time and part-time work has declined.

Race

Examining labor force participation between 1980 and 1998, we see that females 40 to 59 year old make up a growing proportion of full-time workers in all three race subcategories, a trend that is also seen among 20 to 39 year old whites and black females. When examining part-time employment during the same time period, black females that

TABLE 1. Proportion of Females 20 to 59 in Full-Time and Part Time Jobs by Age Cohort:1980 and 1998

	Year: 1980				Year: 1998			
	Full-Time: 20-39 Years	Full-Time: 40-59 Years	Part-Time 20-39 Years	Part-Time 40-59 Years	Full-Time: 20-39 Years	Full-Time: 40-59 Years	Part-Time 20-39 Years	Part-Time 40-59 Years
	Region							
New England	39.2%	38.0%	76.6%	91.1%	40.0%	44.2%	69.1%	71.4%
Mid Atlantic	39.1%	37.7%	70.6%	86.1%	32.3%	42.9%	63.0%	70.0%
E. North Central	38.3%	36.9%	72.3%	86.6%	40.3%	42.5%	66.6%	70.6%
W. North Central	40.0%	38.7%	75.3%	88.8%	41.8%	45.4%	63.7%	66.9%
So. Atlantic	42.5%	39.6%	68.7%	80.4%	43.7%	45.8%	63.5%	67.6%
E. South Central	41.2%	40.7%	66.1%	78.5%	43.8%	43.8%	67.0%	69.3%
W. South Central	40.6%	37.8%	65.0%	80.3%	41.5%	44.2%	64.0%	65.8%
Mountain	39.0%	35.8%	70.1%	83.1%	40.5%	43.5%	60.6%	65.7%
Pacific	40.4%	38.6%	68.9%	80.9%	39.0%	42.2%	58.5%	68.1%
	Location							
Central City	43.2%	41.6%	64.9%	82.7%	42.1%	46.3%	60.5%	65.6%
Balance: SMSA	39.2%	36.1%	72.5%	86.9%	40.8%	42.6%	64.5%	70.2%
Non SMSA	38.3%	38.2%	72.3%	81.3%	41.1%	43.5%	64.6%	69.1%
	Education							
<H.S. Diploma	31.7%	32.6%	62.0%	74.3%	28.7%	36.3%	54.2%	58.8%
H.S. Diploma	43.3%	45.4%	80.1%	90.7%	38.6%	46.8%	62.2%	71.3%
>H.S. Diploma	39.7%	34.4%	66.5%	84.8%	45.4%	43.3%	65.3%	68.8%
	Marital Status							
M. Spouse Pres.	34.8%	31.5%	82.7%	85.4%	38.4%	38.3%	69.9%	68.4%
M. Spouse Absent	55.8%	53.8%	79.3%	74.8%	50.7%	50.3%	71.4%	72.3%
Widowed/Divorced	60.1%	67.1%	79.2%	87.7%	53.9%	60.9%	74.0%	74.1%
Never Married	42.6%	50.1%	49.7%	55.3%	41.3%	48.4%	53.7%	55.4%
	Race							
White	39.0%	37.3%	71.6%	85.1%	40.1%	42.4%	63.5%	69.0%
Black	47.6%	45.0%	62.0%	78.5%	50.0%	51.6%	65.6%	66.1%
Other	46.0%	42.3%	62.1%	77.3%	40.9%	47.2%	55.0%	65.0%

have increased their labor force participation, unlike their white counterparts who experienced a decline.

Gender, Marital Status and Employment: Distributions and Changes

In the period from 1980 to 1998, several interrelated changes have occurred with respect to the labor force. First, most of the Baby Boom (those born 1946 to 1964) have passed from the youngest cohort under study (20 to 39 years of age in 1980) to the older cohort (40-59 years of age in 1998). Second, the economy has changed, especially in the technical area and in the requirements for credentials. Third, the household-family composition, reflected in marital status, has changed.

To provide a snapshot of the changes in full and time employment by marital status by gender for the two age cohorts under study, 20 to 39 years of age and 40 to 59 years of age, marital status and full and part-time employment, Table 2 was constructed. Table 2 examines trends in female full and part-time employment in two age cohorts relative to men. This examination of the proportions of various types of workers in the total labor force provides a way to directly assess if the labor market is remaining dynamic, but fundamentally unchanged in its structure. There are some elements of a zero-sum game operating with some age and sex subcategories doing better as others do worse. Table 2 shows that between 1980 and 1998:

1. Full-time employment for males and females has decreased (85.5% to 78.8%).
2. Full-time employed males have declined relative to all workers (52.6% to 45.5%) while the proportion of full-time employed females is virtually unchanged (33.9% to 33.4%).
3. The younger cohort (20-39 years of age) of males and females who are married with spouses make up a significantly smaller proportion of all full-time employees (males: 21.1% to 13.4%; females: 11.2% to 8.3%) while in the older cohort (40-59) males have declined somewhat (17.1% to 15.3%) and females increased (7.8% to 15.3%).
4. Among the full-time employed, males and females 40-59 who are widowed or divorced showed about the same total percentage growth (males: 1.4% to 2.5%; females: 2.9% to 3.9%).
5. Never married females and males in both age cohorts show a small increase in their proportions to the overall number of full and part-time employed persons.
6. Of those married with spouse present, males have increased their proportion of workers who are working part-time (20-59: 1.3% to 3.7%). The same is true for females (20-59: 7.0% to 8.2%).
7. Widowed and divorced as well as never-married persons with part-time jobs have also seen their proportion of all workers edge upward (widowed, divorced, never married-males: 2.0% to 3.5%; females 2.7% to 5.0%.

Low Income or Deprived Workers

In terms of labor force participation alone, the trend in the feminization of poverty thesis is not particularly conclusive. While there is a gender disparity in income, to look more critically at the contribution of jobs and labor force participation as enhancing or detracting from the feminization of poverty, those making less than $7.05 per hour in constant (1998) dollars were examined.

In 1980, workers (both male and female) holding either a full-time or part-time job and who worked for deprivation income (less than $7.05 per hour) made up 14.1% of the

TABLE 2. Distribution of Labor Force by Full-Time and Part-Time Participation, Marital Status, Age and Gender: 1980 and 1998

		1980 *72,343,350*				1998 *92,573,122*			
		Full-Time		Part-Time		Full-Time		Part-Time	
		38,068,455	*24,529,967*	*2,457,774*	*7,287,154*	*42,091,388*	*30,887,443*	*6,852,761*	*12,741,530*
Marital Status	**Age**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**
Married, Spouse Present	20-39	21.1%	11.2%	0.8%	4.0%	13.4%	8.3%	1.7%	3.9%
	40-59	17.1%	7.8%	0.5%	3.0%	15.3%	9.5%	2.0%	4.3%
Married, Spouse Absent/Separated	20-39	0.8%	1.1%	0.1%	0.2%	0.8%	0.9%	0.1%	0.3%
	40-59	0.5%	0.6%	0.0%	0.1%	0.7%	0.7%	0.1%	0.2%
Widowed or Divorced	20-39	1.8%	2.7%	0.1%	0.4%	1.6%	1.9%	0.3%	0.6%
	40-59	1.4%	2.9%	0.1%	0.5%	2.5%	3.9%	0.4%	1.1%
Never Married	20-39	9.0%	6.7%	1.7%	1.7%	9.6%	6.8%	2.5%	2.9%
	40-59	0.9%	0.9%	0.1%	0.1%	1.6%	1.5%	0.3%	0.4%
		52.6%	33.9%	3.4%	10.1%	45.5%	33.4%	7.4%	13.8%
Total Full Time 1980			86.5%						
Total Part Time 1980					13.5%				
Total Full Time 1998							78.8%		
Total Part Time 1998									21.2%

full and part-time employed persons (n = 72,343,350). By 1998, these ranks increased to 17.7% of the employed (n = 92,573,122). Table 3 examines 20 to 39 year old males and females for the years 1980 and 1998. The proportion of full-time deprived workers during this time remained stable at about 64 %. Of the full-time workers, males grew from 24.2 % of deprived workers to 31.2% of all full-time workers (see Table 3), with the greatest increase seen in the ranks of the non-married. The female decline was primarily found in the ranks of full-time workers who were married with their spouses present. The part-time deprived workers also remained relatively stable at 36%. Of the part-time workers, males grew from 9.6% of the deprived workers in 1980 to 11.8% in 1998.

Table 4 dealing with deprived workers 40 to 59 shows that the proportion of full-time workers increased from 49.7% in 1980 to 66.2% in 1998. Of the full-time workers males increased their proportion of all workers in the deprived category from 13.9% to 25.8% while females increase was more modest, from 35.8% to 40.4%. Among part-time deprived workers, males experienced a slight up turn (4.8% to 6.6%) while females experienced a major decline (45.5% to 27.2%). While the gender disparity remains, the shift away from part-time work along with the growing proportion of males, especially those working full-time, suggests now complementing the female disadvantage is a masculinization of poverty.

Males 40 to 59 who are married with a spouse present and working full-time increased their proportion of deprived workers from 9.7% to 16.0%. They also experienced increases in all other subcategories of marital status. Females also showed increases in each subcategory.

In the part-time subcategories, males increased their proportions in all but the married, spouse absent subcategory while females saw an increase in all marital subcategories, except widowed or divorce and married-spouse present, major declines in the never-married subcategory and married, spouse-absent subcategory.

Table 5 examines the distribution of deprived workers among each of the sex, age, marital status subcategories. It shows that of all full-time workers, married males with spouse present and low income make up a growing proportion of the category. More dramatically, they make up a larger portion of all those who are married and the spouse is absent. Deprived working females who work full-time show a slight downward trend in their proportion to full-time female workers. Part-time working males show increases in the proportion of age-marital subcategories except 40-59 year olds with spouse absent and never-married persons 20-59 years of age. Female part-time workers who earn deprivation incomes have witnessed declines in every age-marital status subcategory.

DISCUSSION

In summary, this study looked at the conditions of labor force participation and pay for the U.S. population based on gender and marital status. The aim was to see if labor force and labor force participation trends are illuminated have bearing on the feminization of poverty thesis. While attention on the feminization of poverty thesis has focused, appropriately, on the household as the unit of analysis, we also looked at labor force participation and income. While many in our study, including those with subpar incomes,

TABLE 3. Distribution of Full-Time and Part-Time Deprived Workers By Marital Status Aged 20-39: 1980 and 1998

Marital Status	Workers Full-Time				Workers Part-Time			
	1980		1998		1980		1998	
	Males	Females	Males	Females	Males	Females	Males	Females
Married, Spouse Present	9.6%	19.2%	10.7%	12.8%	1.7%	14.6%	2.1%	9.3%
Married, Spouse Absent	0.8%	2.3%	1.7%	2.1%	0.2%	1.1%	0.4%	1.4%
Widowed or Divorced	1.2%	4.3%	1.5%	3.2%	0.2%	2.0%	0.4%	1.8%
Never Married	12.6%	13.4%	17.3%	14.3%	7.5%	9.2%	8.9%	12.0%
Total	24.2%	39.2%	31.2%	32.5%	9.6%	27.0%	11.8%	24.5%
Total 1980 (7,633,212)	Total FT: 63.5%				Total PT: 36.5%			
Total 1998 (10,488,986)			Total FT: 63.7%				Total PT: 36.3%	

TABLE 4. Distribution of Full-Time and Part-Time Deprived Workers by Marital Status Aged 40-59:1980 and 1998

Marital Status	*Full-Time Workers*				*Part-Time Workers*			
	1980		*1998*		*1980*		*1998*	
	Males	*Females*	*Males*	*Females*	*Males*	*Females*	*Males*	*Females*
Married, Spouse Present	9.7%	22.8%	16.0%	23.4%	1.7%	19.4%	3.7%	18.5%
Married, Spouse Absent	0.8%	2.5%	2.1%	3.0%	2.0%	7.2%	0.3%	1.6%
Widowed or Divorced	1.6%	8.3%	4.0%	10.3%	0.4%	3.4%	1.2%	5.3%
Never Married	1.8%	2.2%	3.8%	3.7%	0.7%	15.6%	1.3%	1.9%
Total	13.9%	35.8%	25.8%	40.4%	4.8%	45.5%	6.6%	27.2%
Total 1980 (2,547,589)	Total FT: 49.7				Total PT: 50.3			
Total 1998 (7,226,994)			Total FT: 66.2%				Total PT: 33.8%	

can be found in multiple income households, as early trends have indicated, the contribution of additional income is now showing up in married couple families with children under 18 (see Figure 3). Our data suggest that labor force participation has witnessed changes in the older age cohort, 40 to 59 years of age. Figure 3 shows that males seem to be stagnating or witnessing some declines in income while females, still lagging behind in overall pay seem to be very slowly improving.

From these data, we see that the overall number of females in the labor force have increased over the past two decades. This paints a picture of expanding opportunities for women in paid labor, however these are mitigated by the structure of the work. These results show a dramatic shift in the structure of the labor force such that women regardless of age are faced with the difficulty of entering or retaining full-time employment. The default option is availability of part-time participation in the labor force. These jobs are typically low pay positions with little opportunity for advancement. Given the nature of the labor market and household composition, it does not appear that efforts to promote more labor market activity, especially under conditions of capped incomes, will substantially reduce the economic pressures on young families and on a growing portion of the nation's labor force.

TABLE 5. Low Paid Workers by Sex as a Proportion of Workers in Each Marital Subcategory: 1980-1998

Marital Status		Full-Time Workers				Part-Time Workers			
		1980		1998		1980		1998	
	Age	Males	Females	Males	Females	Males	Females	Males	Females
Married, Spouse Present	*20-39*	3.1%	6.3%	5.6%	6.7%	3.6%	33.3%	4.3%	18.9%
	40-59	2.4%	5.7%	3.7%	5.3%	3.0%	34.7%	3.4%	16.8%
Married, Spouse Absent	*20-39*	4.6%	12.9%	11.2%	14.3%	6.3%	41.3%	9.8%	32.7%
	40-59	4.8%	14.2%	8.1%	11.9%	12.8%	41.6%	5.5%	26.1%
Widowed or Divorced	*20-39*	2.9%	10.2%	4.8%	10.6%	4.8%	39.1%	5.1%	24.4%
	40-59	2.3%	11.9%	3.5%	9.2%	4.3%	48.7%	4.8%	20.2%
Never Married	*20-39*	8.5%	9.0%	11.9%	9.9%	23.7%	29.2%	18.6%	25.0%
	40-59	6.2%	7.7%	7.1%	7.0%	23.3%	28.9%	11.3%	15.9%

The current situation is one where females participate at much higher rates, but only in a part-time status, a situation that also confronts males. The availability of full-time employment has declined, especially for females ages 20-39. At first glance, we suspect that the labor market is a good way for females to avoid the drudgery of economic instability. We now come to realize that the mechanism supposed to assist females avoid or pull out of economic ruin is the exact driving force precipitating it. If the labor market was expanding and offering more opportunities for women then ideally there would be a reduction in the number of female-headed households living in deprived economic conditions. However, examining trends in mother-only families living in poverty show this relationship does not hold true. Given the expansion of jobs in the labor market, why then do poverty rates continue to rise? The implication is clear. It is the change in structure of the labor market that has perpetuated the feminization of poverty and inflicted negative consequences on persons living in these economically deprived conditions.

These findings are suggestive in linking economic stability to factors beyond family structure. It establishes a relationship between the economic distress families experience, particularly single-mother families, to the larger society via the labor market. It relates the repercussions of change over time in the structure of the labor force to decreased opportunities to foster financial self-sufficiency for women and their children. These preliminary findings lay the foundation for future studies looking more specifically at labor force participation and wage differentials for women by marital status, taking into account variables like education and occupation.

REFERENCES

Cherlin, A. 1981. *Marriage, Divorce, and Remarriage: Social Trends in the United States.* Cambridge, MA: Harvard University Press.

Becker, G. 1985. "Human Capital, Effort, and the Sexual Division of Labor." *Journal of Labor Economics* 3:33-38.

Bergmann, B.1971. "The Effects of White Incomes on Discrimination in Employment." *Journal of Political Economy* 79(2):294-313.

Bergmann, B. 1986. *The Emergence of Women.* New York: Basic Books.

Blank, R. 1990. "Are Part-time Jobs Bad Jobs?" Pp. 123-55 in *A Future of Lousy Jobs? The Changing Structure of U.S. Wages,* edited by G. Burtless. Washington, DC: Brookings Institute.

Duncan, G. and Hoffman, S. (1985). "A Reconsideration of the Economic Consequences of Marital Disruption." *Demography* 22: 485-498.

England, P. 1999. "The Case for Comparable Worth." *Quarterly Review of Economics and Finance* 39:743-762.

Fuchs, V. 1988. *Women's Quest for Economic Equality.* Cambridge, MA: Harvard University Press.

Haynie, D. and Gorman, B. 1999. "A Gendered Context of Opportunity: Determinants of Poverty Across Urban and Rural Labor Markets." *The Sociological Quarterly* 40(2):177-89.

Hill, M. 1979. "The Wage Effects of Marital Status and Children." *Journal of Human Resources* 14:579-94.

Institute for Women's Policy Research. 1998. *The Male/Female Wage Gap: Lifetime Earnings Losses* (Briefing Paper). Washington, DC: Institute for Women's Policy Research.

Jacobson, J. and Levin, L. 1995. "The Effects of Intermittent Labor Force Attachment on Women's Earnings." *Monthly Labor Review* 118:14-19.

Kodras, J. and Jones, P. III. 1991. "A Contextual Welfare's Work Disincentive:" The Case of Female-Headed Poverty." *Geoforum* 22(2):159-171.

Korenman, S. and Neumark., D. 1992. "Marriage, Motherhood and Wages." *Journal of Human Resources* 27:233-55.

Lord, S. 1993. *Social Welfare and the Feminization of Poverty*. New York: Garland.

Martin, T. and Bumpass, L. 1989. "Recent Trends in Marital Disruption." *Demography* 26(1):37-50.

McNeil, J. 1998. "Changes in Median Household Income: 1969 to 1996." *Current Population Reports,* Special Studies P23-196 (July).

National Bureau of Economic Research. 1999. CD-ROM. *Labor Extracts* from the *Current Population Survey*. 1999.

Preston, S. and McDonald, J. 1979. "The Incidence of Divorce within Cohorts of American Marriages Contracted Since War." *Demography 16(1):1-25.*

Spain, D. and Bianchi, S. 1996. *Balancing Act: Motherhood, Marriage and Employment Among American Women*. New York: Russell Sage Foundation.

Tomaskovic-Devey, D. 1987. "Labor Markets, Industrial Structure and Poverty: A Threshold Discussion and Empirical Example." *Rural Sociology* 52:56-74.

U.S. Census Bureau.2000.*Statistical Abstract of the United States:2000*. Washington, D.C. [on-line:http://www.census.gov/prod/www.statistical-abstract-us.html].

U.S. Census Bureau. 1999. *Statistical Abstract of the United States: 1999*. Washington, D.C. [On-line: http://www.census.gov/prod/www/statistical-abstract-us.html].

U.S. Census Bureau. 1998. *Statistical Abstract of the United States: 1998*. Washington, D.C. [On-line: http://www.census.gov/prod/www/statistical-abstract-us.html].

U.S Census Bureau. 1998a. *Average Number of Own Children Under 18 Per Family, By Type of Family: 1955 to Present.*
[On-line: http://www.census.gov/population/socdemo/hh-fam.html]

U.S Census Bureau. 1998b. *Poverty Status of Families, by Type of Family, Presence of Related Children, Race and Hispanic Origin: 1959 to 1998.*
[On line: http://www.census.gov/hhes/poverty/histpov.html]

Voydanoff, P. 1984. "Economic distress and families: Policy issues." *Journal of Family Issues* 5:273-288.

Waldfogel, J. 1997. "The Effect of Children on Women's Wages." *American Sociological Review* 62(2):209-217.

Waldfogel, J. 1994. "Women Working for Less: Family Status and Women's Pay in the US and UK." Working Paper #D-94-1, Malcolm Wiener Center for Social Policy, Harvard University, Cambridge, MA.

Weitzman, L. 1985. *The Divorce Revolution*. New York: Free Press.
Wellington, A. 1994. "Accounting for the Male/Female Wage Gap Among Whites: 1976-1985." *American Sociological Review 59(6):839-848.*
Zopf, P. Jr. 1989. *American Women in Poverty*. New York: Greenwood Press.

INDEX

2000 MEMBERSHIP ROLL BY SECTION

SECTION I
BIOLOGICAL
SCIENCES
Aarons, David J.
Agee-McWhorter, Grace
Aikman, Stephanie
Alexander, Stephanie
Al-Hamdani, Safaa
Allan, Mary Ann
Angus, Robert
Bagley, Joy E.
Bailey, Mark
Baker, Dan
Barbaree, James M.
Beaird, Janis
Beasley, Phil
Bej, Asim Kumar
Best, Tory L.
Beyers, Robert J.
Blackwell, Eric A.
Blanchard, Paul D.
Boettcher, Anne
Boettger, Stefanie A.
Boggild, Andrea
Bowen, William R.
Boyd, Robert
Bradley, James T.
Braid, Malcom
Brumlow, William B.
Buchanan, Lisa White
Buchner, Richard L.
Campbell, P. Samuel
Canerday, James V.
Carey, Steven D.
Carroll, Jeffrey W.
Carter, Jacqueline
Carter, Gregory A.
Cassell, Gail H.
Clements, Ben A.
Cline, George
Cohen, Glenn
Collier, Lyndell
Conway, Rebecca P.
Conway-Myers, Barbara
Croll, George A.
Croll, Suzanne
Curl, Elroy A.
Dapper, J. William
Davenport, Lawrence J.
Davis, Michelle
Davison, Paul G.
Denton, Tom E.
Diamond, Alvin R.
Diener, Urban L.
Dindo, John
Dusi, Julian L.
Dusi, Rosemary D.
Dute, Roland R.
Duvall, Melody G.
Estridge, Barbara H.
Fadool, Debra A.
Fadool, James M.
Falany, Marina L.
Frandsen, John C.
French, Elizabeth
Gannon, Andrew T.
Garstka, William
Geis, Alyssa
German Nina S.
Gilbert, Jonathan L.
Gray, Steven
Green Kimberly
Greer Stephen
Grizzle, John M.
Gudauskas, Robert T.
Haggerty, Thomas M.
Hall, Rosine W.
Hammer, Hugh S.
Han, Dueg Woo
Harrison, Jennifer
Henderson, James H.
Higgingbotham, Jeri W.
Hileman, Douglas R.
Hill, Curtis E.
Hill, Geoffrey
Holland, Richard, D.
Holliman, Dan C.
Hopkins, Thomas S.
Hunter, Eric
Ivey, William D.
Jandebeur, Thomas S.
Jenkins, Ronald L.
Johnson, Adriel D.
Johnson, Jacqueline U.
Kaufman, Greer
Killough, Gayle H.
Kittle, Paul
Koopman, William J.
Leahy, Joseph G.
Lee, Kara J.
Leitner, Carol
LeLong, Michel G.
Lishak, Robert S.
Loop, Michael S.
Mahon, Andrew R.
Marion, Ken Roy
Mateescu, Madalina
Mayne, Jeffrey
Mayne, Katharine
McCall, John
McClintock, James B.
McGregor, Stuart W.
McKenzie, Gail O.
McLaughlin, Ellen W.

Meade, Mark E.
Measels, Michael
Menapace, Francis, J.
Meyer, Thomas Joshua
Miller, Donna H.
Miller, Harvey
Miller, Michael E.
Mirarchi, Ralph E.
Moore, Debra S.
Moore, Jack H.
Moore, Teresa Kelley
Morgan, Darrell
Moriarity, Debra M.
Morris, James
Moss, Anthony G.
Murdock, Chris
Myers, Michael L.
Nancarrow, D. Virginia
Nance, Marione E.
Nelson, David H.
Neidermeier, William
O'Brien, Jack (John J.)
O'Hare, Sean Patrick
Olander, Charles
Otto, Chris
Panicker, Gitika
Parrish, Scott C.
Pierson, J. Malcom
Powell, Mickie L.
Pritchett, John F.
Quindlen, Eugene A.
Ramsey, John S.
Regan, Gerald T.
Reynolds, W. Ann
Richardson, Velma
Riley, Thomas N.
Roberts, Pamela H.
Robertson, Blair E.
Robinson, George H.
Rohrer, Shirley
Romano, Frank A.
Rowell, Craig
Salter, Donald W.
Samuels, Ivy
Sauterer, Roger
Schlundt, A.F.
Scott, Kaggia K.
Shardo, Judith D.
Shew, H. Wayne
Singh, Shiva P.
Sizemore, Doug
Smith, Bruce F.
Spaulding, Dan
Spector, Michael
Spencer, Elsie
Ssenkoloto, Margaret
Stanko, Jason
Stephens, Patrick
Strada, Samuel J.
Sundermann, Christine
Suppiramanian, Vishnu
Thompson, Larry E.
Thomson, Sue
Thurston, Cindy L.
Tingle, Tracie A.
Tolar, Joe
Turner, William
van Amerongen, Krista
Varner, Morgan
Vawter, Nancy V.
Vickery, Michael C.L.
Walker, J.H.
Walker, Jennifer M.
Wall, Benmamin R., Jr.
Wallace, Brenda
Walser, Chris
Watson, R. Douglas
Watts, Stephen A.
Webber, Cliff
Whipkey, Stephen L.
Whitehead, Alan
Wibbels, Thane
Wilkes, James C.
Wilson, Thomas H.
Wit, Lawrence C.
Woodard, Andrew
Woods, Michael
Wujek, Daniel E.

SECTION II
CHEMISTRY
Abdalla, Mohamed O.
Advincula, Rigoberto
Arendale, William F.
Arnold, Steven E.
Asouzu, Moore U.
Barrett, William J.
Bezoari, Massimo D.
Bradford, Ivy D.
Brouillette, Wayne J.
Brown, Mary Ann Higgs
Bu, Lujia
Bugg, Charles E.
Bush, Russell C.
Cappas, Constantine
Chastain, Ben B.
Claude, Juan Pablo
Crouse, Brian
Dillon, H. Kenneth
Duncan, Wendy
Finkel, Joe M.
Finley, Wayne H.
Friedman, Michael E.
Gabre, Beminet
Gebeyehu, Zewdu
Gray, Gary M.
Haggard, James H.
Hamilton, Tracy
Hazlegrove, Leven S.
Ihejeto, Godwin
Isbell, Raymond E.
Johnson, Eric Scott
Kelly, Janice
Koons, L.F.
Krannich, Larry K.
Ludwick, Adriane
March, Joe
Mays, Jimmy

McDonald Nancy C.
Moeller, Michael
Moore, McDonald
Mountcastle, William
Muccio, Donald
Musso, Tamara M.
Nichols, Alfred
Odutola, J. Adeola
Olive, Brentley S.
Ponder, Morgan C.
Rampersad, Dave
Rawlings, Jill
Riordan, James M.
Rutland, Travis J.
Sheridan, Richard C.
Stanton, Clyde T.
Thomas, Joseph C.
Thomaskutty, Mary G.
Thompson, Davis Hunt
Tieken, V. June
Vallanino, Lidia M.
Verbeck, Guido F.,IV
Vincent, John B.
Vines, Kimberly K.
Vulcan Chemicals
Watkins, Charles L.
Webb, Thomas R.
Weiss, Stephanie T.
Wells, David
Wheeler, G.P.
Wierengo, C. John
Zha, Corgziang (Charles)

SECTION III
EARTH SCIENCE
Bersch, Michael
Blackwell, Keith G.
Brande, Scott
Clark, Murlene
Cranford, Norman B.
Dean, Lewis S.
Fisher, Anthony
Fisher, Stephanie
Geological Survey of AL
Haywick, Douglas W.
Kopaska-Merkel, David
Lamoreaux, P.E.
Lowery, James R.
McMillan, Richard C.
Neathery, Thornotn L.
Neilson, Michael J.
O'Donnell, Daniel J.
Raymond, Dorothy E.
Rindsberg, Andrew K.
Robinson, James L.
Selby, James K.
Sheldon, M. Amy
Sitz, Willard L.
Skotnicki, Michael C.
Stock, Carl W.
Thurn, Richard L.
Trimmier, David A.
Williams, Aaron

SECTION IV
GEOGRAPHY,
FORESTRY,
CONSERVATION,AND
PLANNING
Baucom, Thomas F.
Boyer, William
Brown, James S., Jr
Curtis, Kendrick J.
Dabbs, Merilyn O.
Devall, Wilbur B.
Ehsan, Arjang Ryan
Gardiner, Frederick D.
Gibbs, George S.
Henderson, H.A.
Himmler, Frank N.
Holland, A. Priscilla
Izeogu, Chukudi V.
Kiser, Kelley
Klimasewski, Ted
Kush, John S.
Mance, Angelia
Martinson, Tom L.
McAllister, William K.
Mercer, Terry
Mullen, Michael W.
Richetto, Jeffrey P.
Richey, Chester
Rivizzigno, Victoria
Roy, Luke A..
Strong, William R.
Sutherland, Elizabeth
Tang, R.C.
Vickery, Minako

SECTION V
PHYSICS AND
MATHEMATICS
Aggarwal, Manmohan D.
Alford, William L.
Atkinson, Bruce W.
Bachmann, Kurt T.
Baksay, Laszio
Bateman, B.J.
Bauman, Robert P.
Bearden, T.E.
Beiersdorf, Peter
Belyi, Sergey
Boardman, William J.
Brannen, Noah Samuel
Byrd, Gene G.
Carnevali, Antonino
Comfort, Richard
Datta, Anjali
Essenwanger, Oskar M.
Forte, Aldo
Furman, W.L.
Glotfelty, Henry W.
Harrison, Joseph G.
Hawk, James F.
Helminger, Paul
Holliday, Gregory S.
Horsfield, Christopher
Howell, Kenneth B.
Jenkins, Charles M.

Jones, Stanley T.
Knight, Martha V.
Kornman, Paul T.
Legge, Jennie
Lester, William L.
Lundquist, Charles A.
Marian, Gyongyi
Massey, Julia E.
Menon, Govid
Mixon, Stacy Tyrone
Miyagawa, Ichiro
Moore, Carey
Omasta, Eugene
Reid, William J.
Reisig, Gerhard
Roberts, Thomas G.
Robinson, Edward L.
Ruffin, Paul B.
Sanders, Justin M.
Sharma, P.C.
Shealy, David L.
Smith, Micky
Stanley, Sonya S.
Stewart, Dorathy A.
Swinney, Kenneth R.
Tan, Arjun
Tarvin, John T.
Thomas, Jeffrey A.
Varghese, S.L.
Wheeler, R.E.
Wills, Edward L.
Young, John H.

SECTION VI
INDUSTRY AND
ECONOMICS
Absher, Keith
Alexander, Paulette
Anantharaman, Sekhar
Banks, Bonnie M.
Barrett, Doug
Briggs, Charles
Bullard, William R.
Cameron, Michelle A.
Campbell, Sharon N.
Crawford, Gerald
Ferry, Jerry
Findley, Henry M.
Gabre, Helen G.
Gabre, Teshome
Gabremikael, Fesseha
Griffin, Marsha D.
Jain, Rohit
Jones, T. Morris
Keener, Manuel
Lovik, Lawrence W.
McCain, J. Wayne
Murray, Gerald D.
Pride, Tywana M.
Rahimian, Eric
Singleton, Tommie
Suwanakul, Sontachai
Viohl, Frederick A.
Wheatley, Robert
Williams, Robert J.
Yancey, Donna

SECTION VII
SCIENCE EDUCATION
Alexander, Janet G.
Anderson, Trudy S.
Baird, Bill
Benford, Helen H.
Biddle, Laurie R.
Bilbo, Thomas
Caudle, Sandra I.
Fish, Frederick P.
Froning, Michael
George, Joseph D.
Kastenmayer, Ruth W.
Landers, John I.
Morgan, Eugenia L.
Nall, Jane
O'Brien, James M.
Riggsby, Dutchie S.
Riggsby, Ernest D.
Robinson, Jennifer
Rowsey, Robert E.
Shepard, Susie H.
Shumaker, Anne W.
Smith, Karl Dee
Tinsley, Mandy
Wilson, Karl M.

SECTION VIII
BEHAVIORAL AND
SOCIAL SCIENCES
Banks, Janice
Barty, Peter F.
Beckwith, Guy V.
Brown, David C.
Buckalew, L.W.
Burke, Garfield, Jr.
Burns, Jerald C.
Cantrell, Clyde H.
Easterday, Norman E.
Fisher, Gerald P.
Halbrooks, Elizabeth A.
Harris, Louis M., Jr.
Haynes, Mike
Holliman, Diane Carol
Hudiburg, Richard A.
Johnson, James A.
Jones, Tim R.
Joubert, Charles E.
Luskin, Joseph
Miller, Ellaine B.
Mullins, Larry C.
Newton, Dahlia B.
Norton, Emily C.
Osterhoff, William F.
Pashaj, Irena
Raymaker, Henry, Jr.
Richardson, Roger A.
Roberts, Robin
Taylor, Karen
Trussell, Maureen C.
Van Der Velde, Robert J.
Vocino, Thomas

Weber, B.C.
Wheelock, Gerald C.
Wittekind, Janice
Yeager, J.H.

SECTION IX
HEALTH SCIENCES
Alcazar, Gwendolyn P.
Anderson, Cathy U.
Baggett, Emily Beth
Bannaga, Osman
Barker, Samuel B.
Beaton, John M.
Beck, Lee R.
Bohannon, Alice S.
Boots, Larry R.
Briles, David E.
Buckner, Ellen
Chasens, Eileen R.
College of Nursing S.AL
Conary, Jon T.
Cusic, Anne
Cyrus, Wendy
Davis, Richard
Davis, W.R.
DeRuiter, Jack
Eley, John G.
Emerson, Geraldine M.
Findlay,Margaret
Foster, Portia
French, James H.
Fruh, Sharon
Gilbert, Fred
Goudreau, Kelly A.
Grant, Joan S.
Guthery, Dana S.
Gwebu, Ephriam T.
Gwebu, Noma
Han, Jian
Harris, Jennifer E.
Hays, M. Peggy
Herbert, Donald
Hicks, Julius
Iddins, Brenda W.
Jackson, Charles
Johnson, Vicki Y.
Johnston, Sarah R.
Jones, Jason A.
Katz, Judd A.
Lester, Belinda A.
McCallum, Charles A.
Mullins, Dail W., Jr.
Navia, Juan M.
Nelson, Deborah B.
Parsons, Daniel L.
Phillips, Joseph B.
Pieroni, Robert E.
Pittman, James A., Jr.
Pitts, Marshall
Reed, Linda
Revis, Deborah
Rodning, Charles B.
Ross, M. Candice
Roush, Donald
Rudd, Steven
Rush, Melinda
Schnaper, Harold W.
Selassie, Michael M.
Shoemaker, R.L.
Skalka, Harold W.
Smith, Myra A.
Sprague, Michael L.
Sullivan, Linda
Thompson, Jerry N.
Turrens, Julio F.
Vacik, James P.
White, Carolyn S.
Wilborn, W.H.
Wilder, Barbara F.
Winters, Alvin L.
Wynn, Theresa A.

SECTION X
ENGINEERING AND
COMPUTER SCIENCE
Barrett, John
Bekele, Gete
Bright, Tommy G.
Bryant, Barrett
Cameron, Marietta E.
Craig, Thomas F.
Dean, Susan T.
Donaldson, Steve
Drake, John M.
Feinstein, David L.
Francis, Lara
Garza, Gene G.
Ge, Shanyou
Heran, William H.
Hilyer, William A.
Hollis, Daniel L., Jr.
Hu, Bei
Jacobs, Paul L.
Kurzius, Shelby C.
Parker, Donald L.
Pitt, Robert E.
Pun, Oceana
Raju, P.K.
Ren, Jing
Roy, Sanjeev R.
Selvaraj, Madhanraj
Sloan, Kenneth R.
Sprague, Alan P.
Tao, Tao
Thomas, Robert E.
Venkatasubramnian, L.
Walters, J.V.
Wang, Xin
Wang, Yibing
Wisniewski, Raymond B.
Wong, Daisy
Wu, Xiaqing
Yang, Chunmin
Yerramsetti, Ramesh
Zhang, Mila

SECTION XI
ANTHROPOLOGY
Driskell, Boyce N.
Gage, Matthew D.
Henson, B. Bart
Holstein, Harry O.
Hurley, Molly
Mann, Jason A.
Rowe, Bobby
Runquist, Jeanette
Shelby, Thomas M.
Speegle, Heath F.
Twe, Kyla Elizabeth

Journal of the Alabama Academy of Science, Vol. 71, No. 4, October 2000.

MINUTES

AAS Fall Executive Committee Meeting
Southern Research Institute
Birmingham, Alabama
October 21, 2000

The minutes of the Spring meeting were approved.

B1. Dr. Omasta introduced the members of the Board of Trustees who were present at the meeting.

B2. Report of the President -- Dr. Hudiburg is to put names of officers and committee members on the internet.

B6. Treasurer's Report: Dr. Krannich noted a total of $72,814.32 in the treasury. This is about $3400 less from what we had one year ago, but the Academy has not yet received the income check from Samford University for last year's meeting. The dues situation is about what it was last year at this time. The Academy might have to pay (out of this year's money) for the second issue of the Journal (numbers 3&4).

Krannich moved (Omasta 2d) to accept the budget. The motion passed unanimously.

B7. Dr. Bradley was absent but Dr. Hudiburg brought up the idea of accepting an offer by the Gale Group to make the ***Journal of the Alabama Academy of Science*** available electronically to the subscribers. It is felt that such a move would encourage more investigators to submit manuscripts to the journal. Such a contract is a three-year commitment and requires that we continue to produce a hard copy during that time. Dr. Krannich moved (Romano 2d) to permit Dr. Hazlegrove to sign the contract for the Academy. After considerable discussion, the motion passed unanimously.

B8. Counselor to the Alabama Junior Academy of Science -- Dr. Bateman briefly discussed the problem of block scheduling and its impact on the number of schools participating in the Junior Academy.

B9. Science Fair Coordinator -- There was no report but the committee discussed the need to fill this position. Names of possible candidates were mentioned, and Dr. Omasta agreed to contact these people. Also discussed was the money available for this officer to use to carry out the coordinator's job. Finally Ellen Buckner requested that the Resolutions Committee thank Mary Thomaskutty for her service.

B11. Counselor to AAAS -- a person was suggested to fill this position, and Richard Hudiburg promised to contact him.

B12VII. Jane Nall presented a brief oral report.

C3. Anne Cusic was absent; instead, Ken Marion discussed the possibility of allowing Academy members to pay dues for more than one year at a time.

C5. Long Range Planning -- There was considerable discussion regarding the establishment of a web site. Richard Hudiburg was willing to take on the project. Also needed was the need for a secretariat.

C9. Place and Date of Meeting -- the following represent future meeting sites and dates:

Site/Date	Local Chair		
Auburn 2001	Dr. Barbaree	334-844-1647	barbajm@auburn.edu
U. of West Alabama 2002	Dr. Holland	205-652-3414	rholland@uwa.edu
Jacksonville State U. 2003	Dr. Romano	256-782-5038	fromano@jsucc.jsu.edu

C10. Newsletter -- Lynn Stover, Chair of the Newsletter Committee, wishes to resign. There was discussion as to whether we need a newsletter in addition to an active website. Richard Hudiburg agreed to study the situation, and we would make a final decision at the Spring meeting.

C16. Resolutions -- Richard Hudiburg suggested resolutions thanking Mary Thomaskutty and Sam Barker for their years of service.

C19. Gorgas -- Ellen Buckner indicated that the Gorgas Committee was dealing with the question of whether to allow students to take Gorgas money to colleges out-of-state. The Committee chose to study the question and then revisit it next year.

E. New Business -- see handout. Amy Sheldon, the mentor of a student who was recently disqualified at the International Science and Engineering Fair, described the situation to the Executive Committee. After considerable discussion, Ellen Buckner moved (Michael Moeller 2d) to look into this situation (along with Ms. Sheldon) and, if appropriate, write a letter to the ISEF group, addressing: (1) the nature of the transgressions thought to have occurred; and (2) asking for clarification of the rules for future reference. Am Sheldon also proposed a joint meeting this Spring between the AAS and the Alabama Imaging and Microscopy Society (AIMS). Roland Dute, a member of Auburn's Committee on Local Arrangements, asked her to contact James Barbaree, the committee chair, with her request.

Meeting adjourned.

Auburn University Printing regrets the low quality of printing for figures in papers by George Keller and by James T. Bradley and co-workers published in the July, 2000, issue of the *JAAS*. These figures are republished at their original size on the pages that follow.

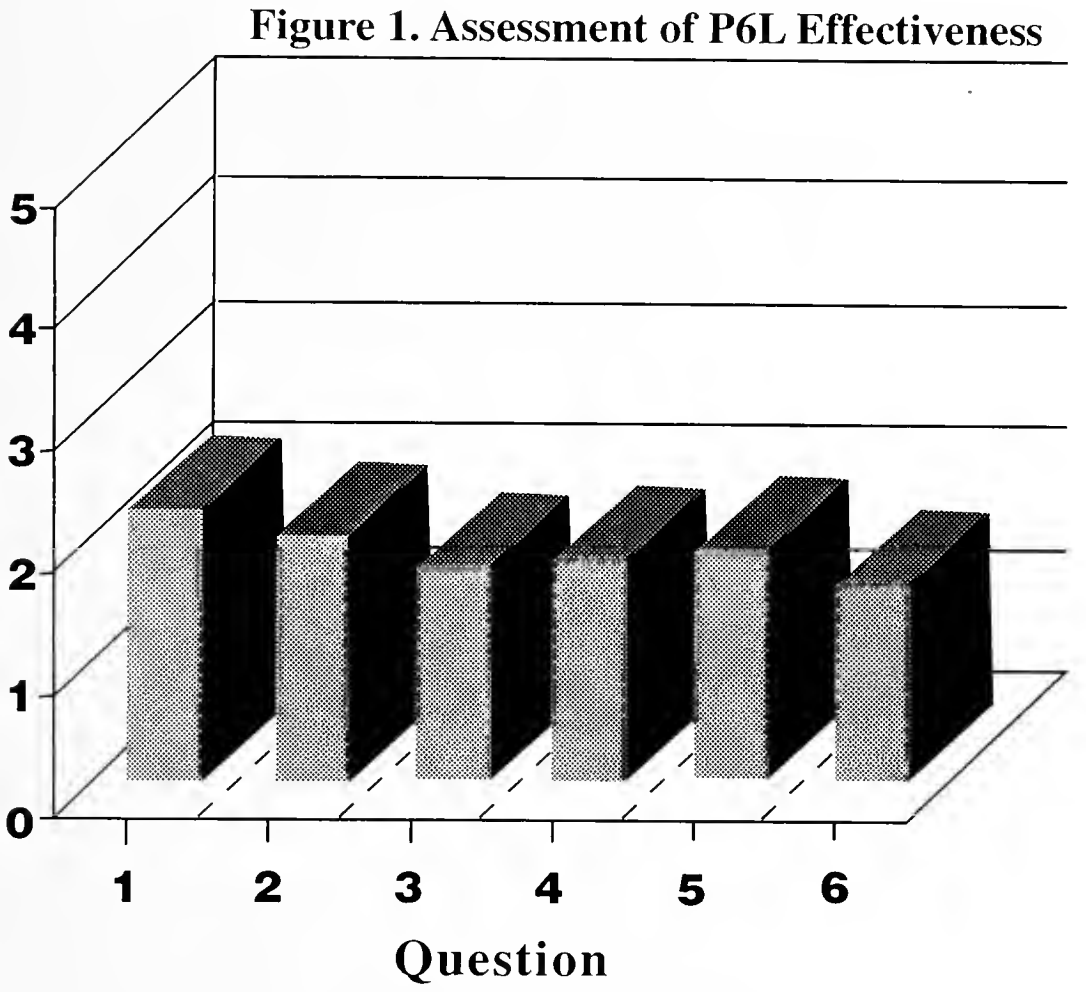


Figure 1. *JAAS* 71(3):107.

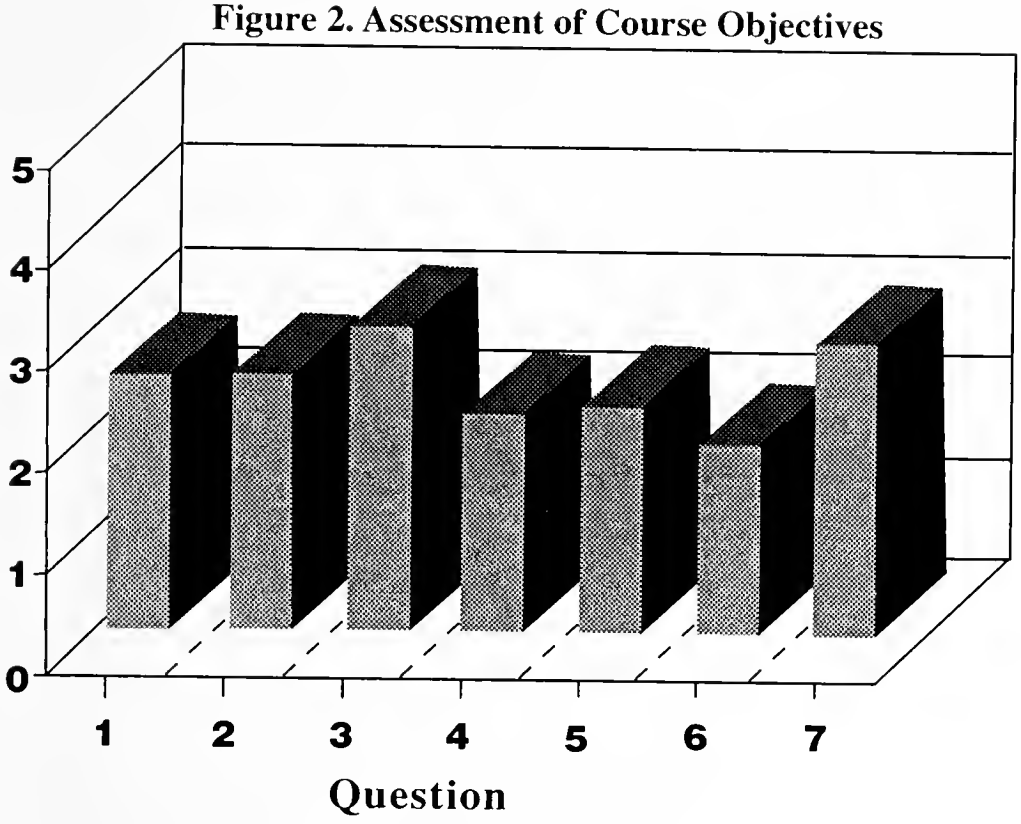


Figure 2. *JAAS* 71(3):108.

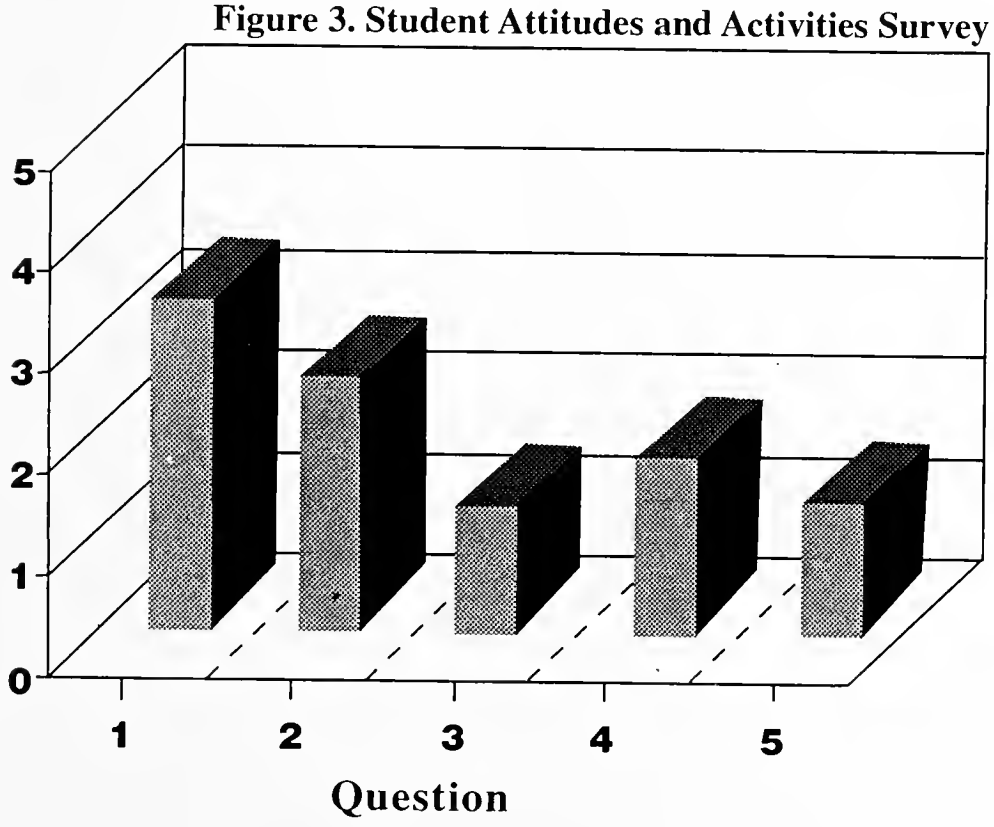


Figure 3. *JAAS* 71(3):109.

Errata

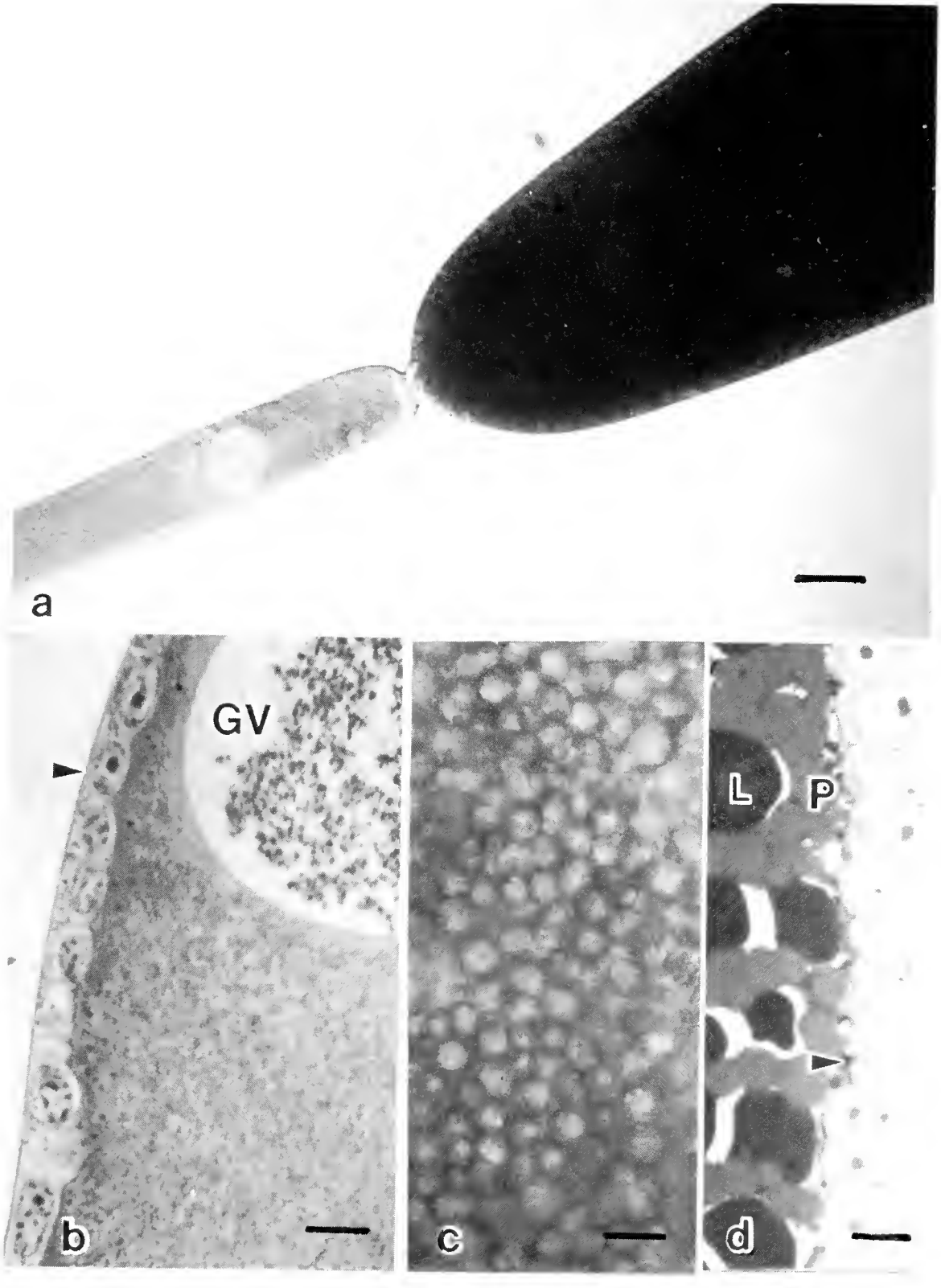
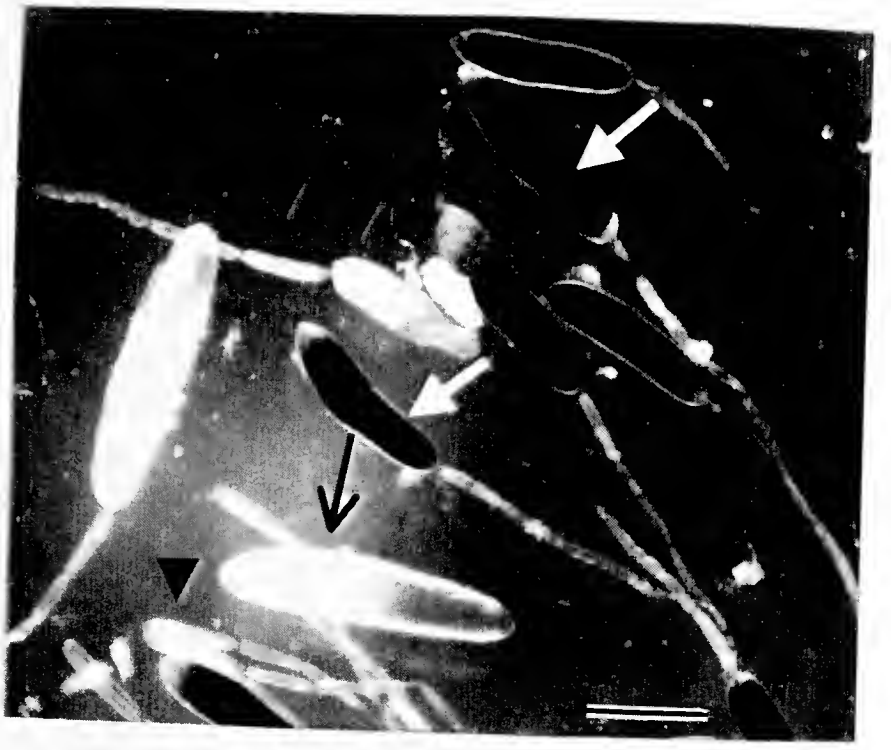


Figure 1. *JAAS* 71 (3):135.



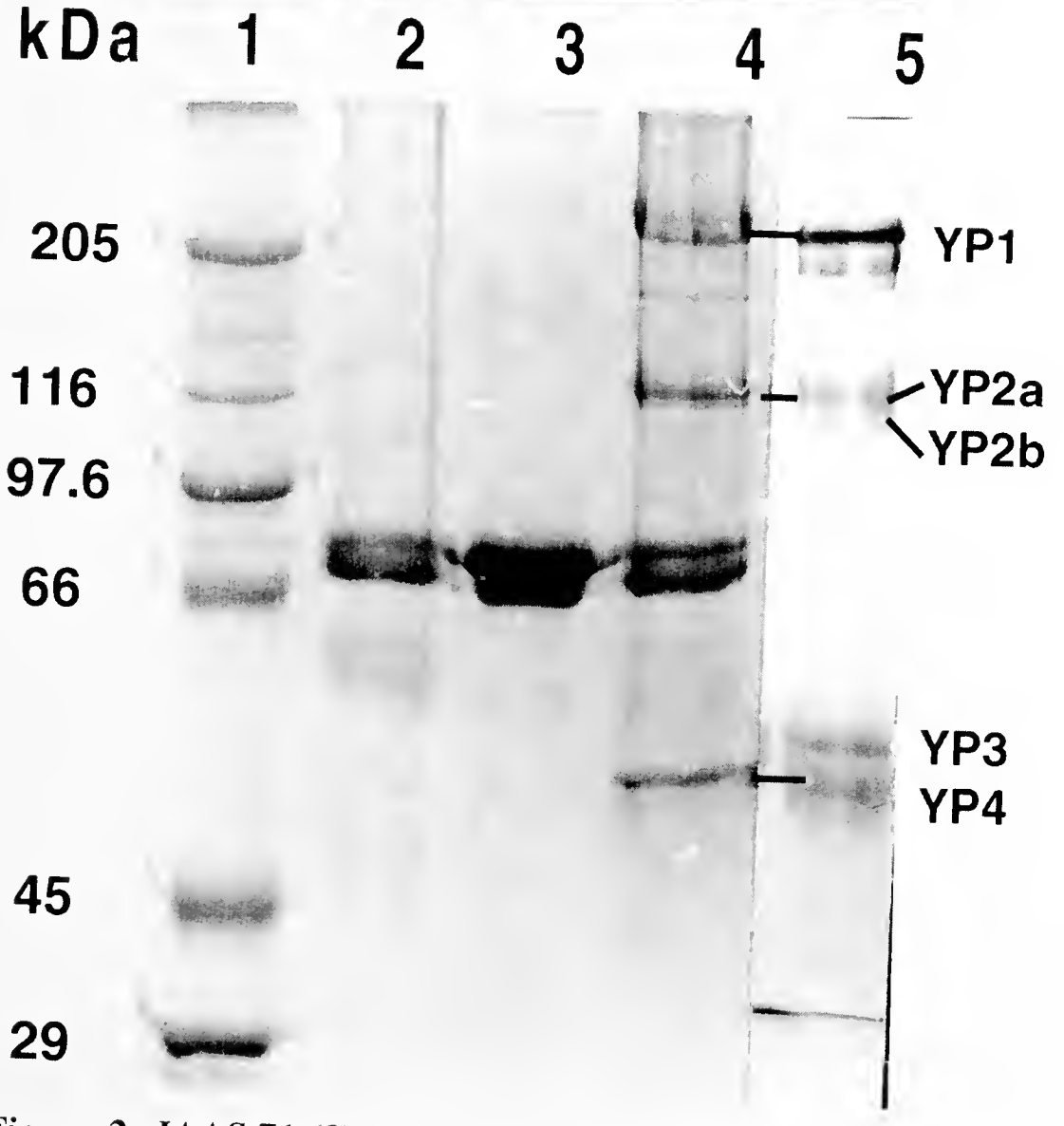


Figure 2. *JAAS* 71 (3):136.

Errata

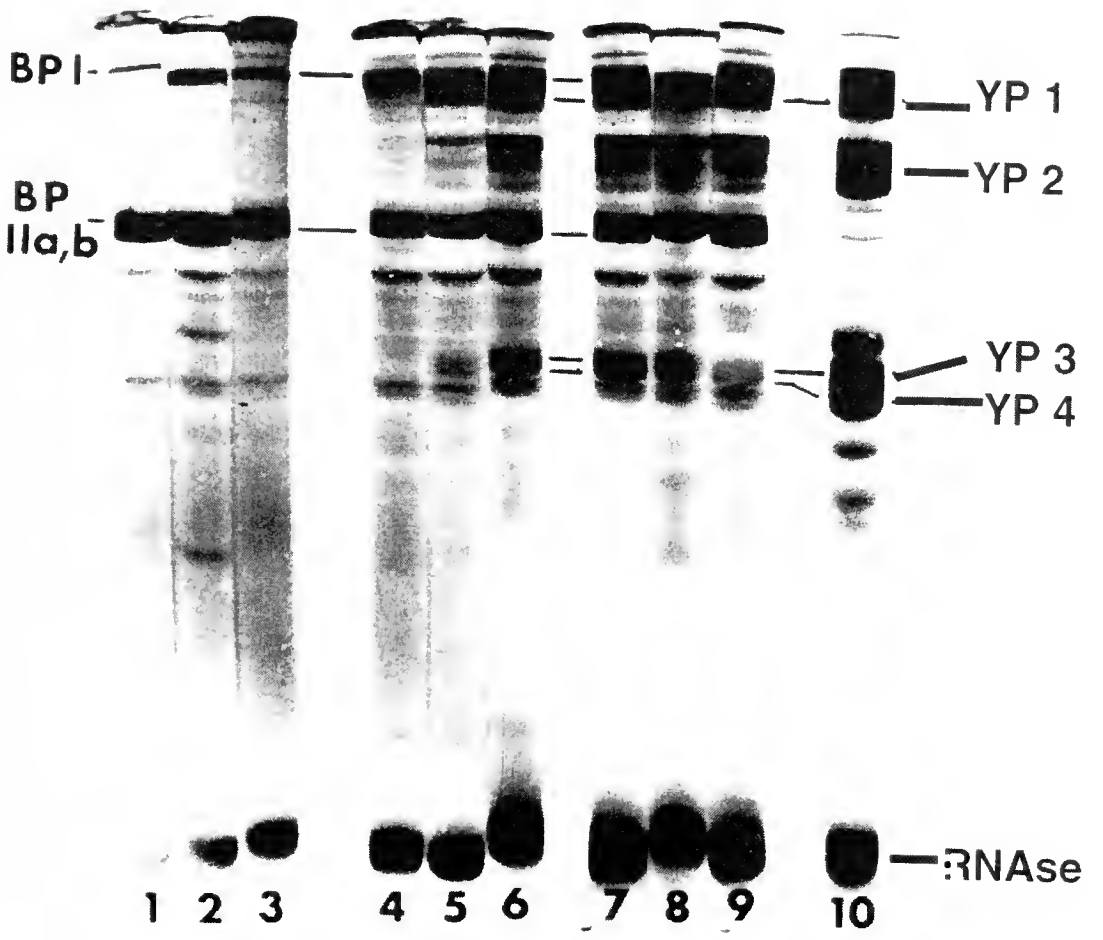


Figure 6. JAAS 71 (3):145.

INSTRUCTIONS TO AUTHORS

Editorial Policy: Publication of the *Journal of the Alabama Academy of Science* is restricted to members. Membership application forms can be obtained from Dr. A. Priscilla Holland, Office of Research, UNA Box 5121, University of North Alabama, Florence, AL 35632-0001. Subject matter should address original research in one of the discipline sections of the Academy: Biological Sciences; Chemistry; Geology: Forestry, Geography, Conservation, and Planning; Physics and Mathematics; Industry and Economics, Science Education; Social Sciences; Health Sciences; Engineering and Computer Science; and Anthropology. Timely review articles of exceptional quality and general readership interest will also be considered. Invited articles dealing with Science Activities in Alabama are occasionally published. Book reviews of Alabama authors are also solicited. Submission of an article for publication in the implies that it has not been published previously and that it not currently being considered for publication elsewhere. Each manuscript will receive at least two simultaneous peer reviews.

Submission: Submit an original and two copies to the editor. Papers which are unreasonably long and verbose, such as uncut theses, will be returned. The title page should contain the author's name, affiliation, and address, including zip code. The editor may request that manuscripts be submitted on a diskette upon their revision or acceptance.

Manuscripts: Consult recent issues of the *Journal* for format. Double-space manuscripts throughout, allowing 1-inch margins. Number all pages. An abstract not exceeding 200 words will be published if the author so desires. Use heading and subdivisions where necessary for clarity. Common headings are: **Introduction** (including literature review), **Procedures** (or **Materials and Methods**), **Results, Discussion,** and **Literature Cited.** Other formats may be more appropriate for certain subject matter areas. Headings should be in all caps and centered on the typed page; sub-headings should be italicized (underlined) and placed at the margin. Avoid excessive use of footnotes. No not use the number 1 for footnotes; begin with 2. Skip additional footnote numbers if one or more authors must have their present address footnoted.

Illustrations: Submit original inked drawings (graphs and diagrams) or clear black and white glossy photographs. Width must not exceed 15 cm and height must not exceed 20 cm. Illustrations not conforming to these dimensions will be returned to the author. Use lettering that will still be legible after a 30% reduction. Designate all illustrations as figures, number consecutively, and cite all figures in the text. Type figure captions on a separate sheet of paper. Send two extra sets of illustrations; xeroxed photographs are satisfactory for review purposes.

Tables: Place each table on a separate sheet. Place a table title directly above each table. Number tables consecutively. Use symbols or letters, not numerals, for table footnotes. Cite all tables in the text.

Literature Cited: Only references cited in the text should be listed under **Literature Cited.** Do not group references according to source (books, periodicals, newspapers, etc.). List in alphabetical order of senior author names. Cite references in the text parenthetically by author-date.